U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF ENTOMOLOGY—BULLETIN No. 54.

L. O. HOWARD, Entomologist

SOME MISCELLANEOUS RESULTS OF THE WORK OF THE BUREAU OF ENTOMOLOGY.

VIII.

PREPARED UNDER THE DIRECTION OF THE ENTOMOLOGIST.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1905

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Entomology,
Washington, D. C., May 1, 1905.

Sir: I have the honor to transmit herewith the manuscripts of several articles and shorter notes, none of which are of such a nature as to justify their publication at this time in separate form. The matter presented is similar to that which has been published in seven earlier bulletins, and I recommend its publication under the title "Miscellaneous Results of the Work of the Bureau of Entomology—VIII," as Bulletin 54 of this Bureau. The initial article on the sugar-cane beetle is a report of an investigation conducted during 1904, which was made necessary by the fact that the insect in question had received practically no attention at the hands of entomologists for a quarter of a century. The suggestion as to remedies will, it is hoped, be found useful to sugar planters of the South. The report on "Conchuela," a cotton pest of Mexico, contains an account of investigations conducted because of an unusual outbreak during the year, which afforded the possibility of a thorough study of this insect. It may be in time a dangerous enemy to cotton cultivation in Texas, and possibly in other near-by States in which it also occurs. The sugar-beet crown borer has not previously been detected injuring sugar beet or other useful plants. The dock false-worm, considered in the next article, is also new as a pest, as is the pepper weevil, so far as regards published records. Everything points to the accidental introduction of the weevil from Mexico. The article on cold storage for cowpeas is of value for obvious reasons, one of which is that the experiments reported have been conducted over a considerable period and the cost of this method of treating seeds has been definitely ascertained; it is also shown that the vitality of the seed is not injured by treatment. The larger canna leaf-roller and pond-lily leaf-beetle have been unusually destructive during the year, and have not previously been treated in any publications of this Department. The report on the grasshopper conditions of the West shows that grasshoppers have been, on the whole, very much less destructive during the year 1904 than is usual. It also

demonstrates the value of remedies, which are more effective when the insects are not overabundant, and should then be practiced as a means of limiting injurious occurrences in the immediate future. The article entitled "Collective Notes on the Behavior of the Colorado Potato Beetle in Great Britain" indicates that this American insect does not now exist in England, but that it is capable of flourishing to a remarkable degree on the Continent. Some interesting facts in regard to the use of hydrocyanic-acid gas as a remedy for indoor insects have been gained during the year, a portion of which are embodied in an article and a note in this series. During the year Mr. Frederick Maskew, of California, has cooperated with this office in several investigations, two of which are made public—one on the subject of Fuller's rose beetle and the other on the success of an introduced ladybird beetle. Among general notes are short accounts of a very injurious caterpillar enemy of velvet bean in Florida, an instance of the complete destruction of the imported cabbage worm by parasites, and other notes of minor interest.

Respectfully,

L. O. Howard,
Entomologist and Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

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VIII.

THE SUGAR-CANE BEETLE.

(*Ligyrus rugiceps* Lec.)

[With notes on associated species.]

By E. S. G. Titus.

In 1880, in southern Louisiana, there occurred a serious outbreak of the sugar-cane beetle, so disastrous in its effect on the sugar yield that many planters gave up the growing of this crop and turned their energies to rice cultivation. This was especially true along the Mississippi River north of New Orleans and at some points along the Southern Pacific Railroad.

From 1880 until the present time there have been many reports of injury caused by this beetle (and some other closely related species) to sugar cane, corn, and other crops. Throughout Louisiana, Mississippi, and other Southern States, and even so far north as North Carolina in the east and Iowa in the west, have come reports of a beetle that "eats into the plant to the heart." The injury to corn in the north is usually caused by *Ligyrus gibbosus* DeG., a species very closely related to the sugar-cane beetle. The reports of injury to sugar cane appear to be on the increase throughout the sugar-cane growing States, doubtless partially owing to the fact that considerable new land is each year being opened for cultivation and also to the fact that the planters are beginning to notice more closely when they see their crops suddenly cut down.

Under instructions from the entomologist, two trips were made by the writer in 1904 to Louisiana to study the life history of this insect—one in April and May and the other in the latter part of October, when the cane harvesting was in progress.

An investigation of the 1880 outbreak was made by Dr. L. O. Howard in the spring of that year, his report being published as Special Report No. 58 of the Department of Agriculture, and later appearing in the report of the Commissioner of Agriculture for 1880.[a] In this report there is given a very complete account of the history of the

[a] 1881: Rept. Comm. Agric. f. 1880, pp. 236–240.

beetle as known at that time, its method of attack, and some suggestions regarding remedies.

The sugar-cane beetle measures from one-half to five-eighths of an inch (15 to 18 mm.) in length, is jet black above and black and piceous beneath; head roughly shagreened; thorax with minute rather sparse punctures; elytra with longitudinal striæ and many small punctures; thorax and elytra polished and shining; on each wing cover near the tip a smooth, slightly elevated prominence, beyond which the elytra are abruptly truncate; abdomen projecting slightly beyond the tips of the elytra. The legs are coarsely spined, the front tibiæ being broad and armed with four large, broad teeth. This species can be readily separated from the rice beetle (*Chalepus trachypygus* Burm.) by its smaller size and more parallel sides. The rice beetle is more rounded across the thorax and elytra. The carrot beetle (*Ligyrus gibbosus* DeG.) is distinguished readily by the under side of the abdomen being quite densely covered with reddish hair.

HABITS AND METHOD OF ATTACK.

At the time of the first trip in 1904 much of the sugar cane was from 10 to 18 inches high. The previous season had been rather unfavorable, owing to excessively dry weather, and in some fields the cane was sprouting poorly. Plant cane continued to sprout and push through the ground until late in June, and many of the buds on mother cane that were examined in April and May had died from lack of sufficient moisture.

During the four weeks of the first trip the principal cane-growing regions of Louisiana were visited, special attention being paid to plantations at Olivier, Berwick, Morgan City, Broussard, and St. James. At all places visited the beetle was found injuring cane severely. In some of the districts it was reported that this was the first year there had been serious injury, but most of the planters interviewed stated that they had had more or less loss from the beetles for several years. Those who had been raising cane for long periods could recall records of injuries at varying intervals for the past forty-five or fifty years. Especial injury was reported to have occurred in 1884, 1880, 1876, 1872, and once before the civil war—about 1856–57. At times, in some areas, almost the entire cane and corn crops had been cut down.

This past year (1904) the beetles commenced work on the cane before the tips had appeared above the ground and continued until early in July to do serious damage. The injury to corn began as soon as the corn appeared above ground, whole fields being, in many cases, completely laid bare; and even the second planting was destroyed.

The injury is usually made a few inches below the surface of the ground, in cane generally 1 or 2 inches above the base of the stalk.

FIG. 1.—*Ligyrus rugiceps:* cane showing injury—one-half natural size (original).

The depth below the surface of the ground of course depends much upon the previous treatment of the cane and the amount of dirt

thrown up by the early cultivations. The beetles cut a horizontal burrow into the growing stalk until they reach the center, the center roll of leaves usually being cut through. The coarser fibers of the outer sheaths are shredded away with the mandibles and front tarsi, the latter being used more especially to pull away the stringy fibers after they have been cut loose at one end. As soon as the hole is large enough for the head and a portion of the thorax, the beetle uses the middle legs as braces while it cuts its way deeper into the stalk (fig. 1). Some instances were noticed where small and tender shoots had been entirely cut through and in a few cases shoots that stood against a larger stalk had been cut through, the beetle continuing its work into the next stalk. The beetles seemed indifferent to the size of the stalk attacked, larger older shoots being injured as often as the small tender ones, even when growing in the same clump of cane. The effect on the shoots is very different from that on the older stalks, the latter sometimes recovering from the injury if not too severe, while the former soon wilt, the center leaves dying first. On account of the beetles' habit of working underground it was found very difficult to determine the length of time necessary to cut a hole to the center of the stalk. One beetle was seen to enter the ground, and twenty minutes later it had reached the center of a a stalk three-fourths of an inch in diameter, as was readily determined by pulling out the central core of leaves. At times stalks containing several partially completed and one complete burrow are to be found. Usually but one cutting is made on a stalk, and, if this reaches through the central core of rolled leaves, the shoot quickly dries up and in a few days falls to the ground. When examined, the point at which the cutting was made now appears decayed, and in and on the rolled leaves in the interior may often be found small dipterous larvæ feeding on the fermenting and decaying cane or corn.

FIG. 2.—*Liggyrus rugiceps:* corn showing injury (after Comstock).

Corn is attacked in the same manner as cane (fig. 2), but the injury is usually closer to the base of the stalk and more disastrous in its

effect, since corn rarely suckers when thus cut back. On grass, on account of its small diameter, the beetles nearly always sever the attacked stem.

LIFE HISTORY.

The female beetle does not appear to attack the stalk, primarily at least, for the purpose of obtaining food, but in order that the cane may be deadened and the roots may soften and decay so as to afford a place for the young larvæ to live and feed. The female, after cutting the hole in the stalk, burrows down among the young rootlets alongside the stalk, sometimes going beneath the old stalks of mother cane, and there deposits an egg. It was not possible to ascertain the number of eggs laid by a single beetle. Under natural conditions the beetles appear to always lay the egg after having made the cut in the stalk. Usually but one egg was found for each cut in a cane stalk, but some instances were discovered where there were two or more and in one case ten. The case where the ten eggs were found was in stubble cane, a large clump having but a single sprout growing from it. Some stalks were found that had been attacked by beetles as many as six times, and in one there were four of the cuts that reached to the center or beyond. No attempt was made to ascertain the exact number of eggs contained in the ovaries of the female, but from those examined I should judge it would exceed a hundred. Eggs of this beetle were first found in the ground April 28, but the size of young larvæ present at that time in the cane fields—which I could not distinguish from those later hatched from the cane beetle eggs—would show that the egg-laying period begins much earlier.

The egg of *Ligyrus rugiceps* is pure white, shining, smooth, polished, globular, 0.75 mm. in diameter, and does not appear to differ from the egg of *Chalepus trachypygus*, *Ligyrus gibbosus*, or *Cyclocephala immaculata* except in size. It is slightly smaller than the eggs of the first species mentioned, somewhat larger than the second, and nearly twice the size of the last.

The young larvæ begin to show in the egg the third day after deposition, but the time of emergence varies greatly, from six to fifteen days being required in those under observation in the field. Hot, moist soil hastens their development, while cold soil with either excessive wet or dry weather retards it, and cold, wet weather even causes some larvæ to die in the egg.

The larva on emerging makes but a small cut and then splits the shell open by movements of the head and body. The newly hatched larva is almost transparent; the anal end is densely white, while the head and appendages (except the white palpi and the black tips of the mandibles), the tips of legs, and the first thoracic segment are dark brown. Young larvæ hatching from eggs lying on top of the soil in a

warm, damp box made no attempt to enter the soil until from fifteen to twenty-nine hours old. Young, apparently freshly hatched larvæ in the field were often found in the soil near to the eggshell from which they had probably emerged. Those larvæ observed were not seen to feed until at least twenty-four hours had elapsed, and then a slight discoloration began to show through the thin skin. Fine particles of dirt were found at this time in the digestive organs. The larvæ are very sluggish in their movements, unless turned out on a dry, warm soil in the sun, when they hasten to burrow beneath the surface, going only a short distance and soon making a tiny cell in the earth, where they curl up in the characteristic manner of white grubs.

The life history from the middle of May until the last of October is not yet definitely known. The last of October larvæ were found in the fields in considerable numbers in the same positions as those seen in the spring; also in the mother cane, upright stubble cane, and even at the bases of growing cane stalks. Quite a number of the larvæ are now in our breeding cages in Washington (April 1), but none have as yet transformed. Many of those dug out of the cane fields in October had formed earthen cells of considerable solidity and were evidently full grown. These cells were usually placed 5 to 6 inches below the surface and often close to the canes. A few were found in the mother cane. Some were discovered at the summit of stubble cane, 3 to 4 inches beneath the surface, where they had apparently fed for most of their lives (see fig. 4). None of the cells found in the cane fields had parasites in them, but *Eraxlateralis* larvæ, one to two-thirds grown, were several times found near injured white grubs. But two pupæ were found in the fields, and from one of these, early in November, there emerged an adult of *Ligyrus rugiceps*. The other pupa was injured in transportation and died.

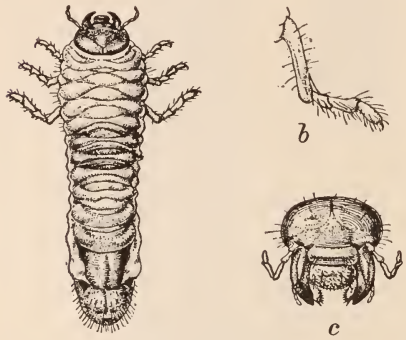

FIG. 3.—*Ligyrus rugiceps:* larva slightly enlarged; *b*, leg; *c*, face view of head, more enlarged (original).

A few adults of *Ligyrus rugiceps* and one of *L. gibbosus* were found in earthen cells at Olivier and St. James. Adults are not usually common in the fields in October, but a few may be found in the soil of fields that have shown the most injury the previous spring, some being in earthen cells, others in the loose soil. A few adults were also found in the soil at the bases of clumps of "Grand Marais" grass (*Paspalum dilatatum*). Adults did not appear at lights at any time in October and very rarely in the spring, nor were they seen

flying in the daytime in the fields, as was the rice beetle. In April and May collections of beetles coming to light were made at Morgan

FIG. 4.—*Ligyrus rugiceps:* stubble cane showing feeding place of larva—two-thirds natural size (original).

City, on the shores of Atchafalaya River, Berwick, Olivier, St. James, Donaldsonville, Lafayette, New Iberia, and St. Charles in Louisiana, and at Beaumont in Texas. The percentage of cane beetles coming to light was extremely small when compared with *Chalepus trachypygus*, the rice beetle. In the fields in the spring practically no rice beetles occurred, while at lights fully 90 per cent of the beetles belonged to this species. The remaining percentage was divided among Hydrophilidæ, Lachnosterna, and the sugar-cane beetle. *Ligyrus gibbosus* was rarely seen at lights, and not over 3 per cent of the beetles were *L. rugiceps*.

OTHER SPECIES OCCURRING IN FIELDS.

Of the other white grub larvæ occurring in the cane fields in early spring and summer, the most common appears to be that of *Cyclocephala immaculata* Ol. The adult of this species is a much smaller beetle, pale in color, and with dark markings. Nearly full-grown larvæ were found not uncommonly in the fields in April and May. They occur at the bases of the stubble cane and beneath grass roots along the margins of the fields. It may be this species that is reported as cutting suckers of the cane late in the summer. The injury is reported to be of nearly the same character as that of the cane beetle, but the holes are smaller. Adults appeared in our breeding cages in Washington early in July and laid their eggs freely in rich soils. The eggs hatched from six to fifteen days after deposition, the white grubs at once forming tiny cells in the soil and within twelve hours beginning to show traces of soil in their intestinal tracts.

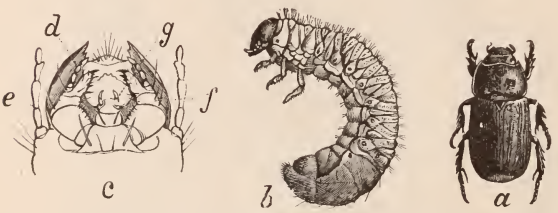

FIG. 5.—*Chalepus trachypygus: a*, beetle; *b*, larva, natural size; *c*, under side of head in detail, enlarged (after Comstock).

It is quite probable that the eggs in nature are laid in the same general way as those of *Ligyrus rugiceps*, but since the species appears so late in the year there will rarely be sufficient damage to cause remedies to be sought for other than those later on recommended for the sugar-cane beetle.

It is probable that the rice beetle does some damage to the cane fields, especially in the rice regions, where it occurs in enormous numbers. Very rarely was it found in the spring, in the soil around the cane, or cutting cane, as was the cane beetle. Eggs were twice found that apparently belonged to this species, but they could not in the field be distinguished from those of the Ligyrus. Attempts to

get eggs from adults in captivity were unsuccessful, but eggs, apparently fully developed, were dissected from these beetles.

Ligyrus gibbosus occurs in the fields, but not commonly. It was bred from larvæ found beneath young cotton plants in recently manured soil. It was also noticed in a few instances cutting cane. Its eggs are a trifle smaller than those of the sugar-cane beetle and are placed in the same positions about the roots of the cane. Adults bred from the cotton fields emerged early in May from pupæ formed in captivity about ten days previous. In the northern part of Louisiana this species has at times been very destructive to corn in early spring, and its ravages in the northern corn States are well known. At times it occurs in truck gardens and will doubtless be found breeding wherever the soil is enriched sufficiently with stable manure.

ENEMIES.

Birds.—Blackbirds may be considered as one of the most efficient enemies of white grubs throughout the South. Unfortunately, however, they are becoming each year more scarce in many parts of Louisiana, owing to the fact that the class of immigrants now coming into the State as plantation laborers are constantly, in their spare time, on the outlook for birds, and especially all small birds, for use as food. In the evenings I have several times noticed laborers coming home from a hunt with blackbirds, quail, sparrows, and other small birds. None of these seem to come amiss for food and the direct result is rather hard on the bird population.

Insects.—Cocoons of a hymenopterous parasite, probably a species of Tiphia, were found in the cells of a Cyclocephala and a Ligyrus in a few fields at Olivier, and in several places in cells of white grubs beneath the roots of Grand Marais grass. But one specimen was bred out, and this was too badly damaged to admit of identification.

Dipterous larvæ (*Erax lateralis* Macq.) (fig. 6), were not uncommon at several places in the sugar-cane region. These usually occurred at the base of stubble cane or in decaying mother cane, but a few were found among grass roots. In almost every instance there were found with them either injured white-grub larvæ or portions of the harder remains of such larvæ or pupæ. From nearly full-grown larvæ taken in the spring there emerged, during the latter part of June and early July, several specimens of a predaceous fly determined by Mr. Coquillett as *Erax lateralis* Macq.

The full-grown larvæ are about 20 to 25 mm. long, very slender, shining white, with darker spiracles and a dark chitinous head.

The puparia are deep brown in color, the spines being almost black.

Adult flies vary considerably in size, being from 20 to 28 mm. in length; the thorax is dark brown, more or less covered with a gray

pubescence; abdomen black, shining, with a narrow band of gray hairs at tip of first segment, sometimes interrupted in the middle; second and third segments with apical triangular gray patches at sides; anal segments pale or covered with pale pubescence; the other segments may have gray patches on the sides. Adults of this fly were not uncommonly taken in October, and were at that time seen capturing wild bees of several species and an unidentified butterfly. They are very swift fliers. Small dipterous larvæ, found in the fall in the cane fields with injured larvæ of white grubs and in cells made for pupation, will doubtless prove to be this same species.

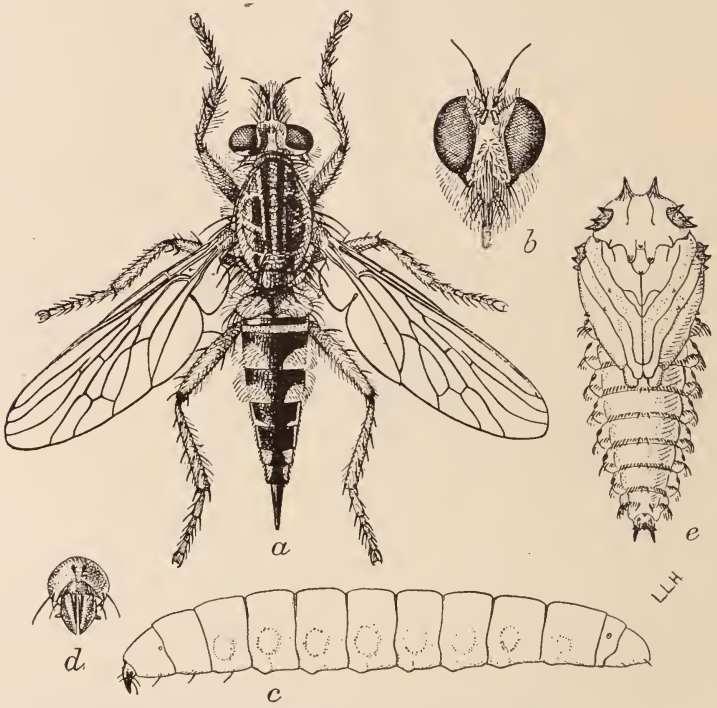

FIG. 6.—*Erax lateralis: a,* adult; *b,* face view of head of adult; *c,* larva; *d,* head of larva; *e,* puparium—all enlarged (original).

Several carabid larvæ were seen in the fields feeding upon young white grubs, but none were reared to maturity.

REMEDIES.

Cultural remedies.—These will doubtless prove to be most successful. Doctor Howard, in his report on this insect in 1880, advised postponing the planting of infested fields until spring. This will prove to be one of the best remedies, especially on the higher, lighter soils. On two large plantations at Broussards it was suggested by the writer that the owners "offbar" the cane in April and May and keep the dirt away from it as late as possible. This suggestion was

also tried at St. James on a portion of one plantation. The other fields on this plantation were handled in the ordinary manner. The offbarred stubble-cane yielded from 15 to 17 tons, while that handled in the ordinary way was yielding from 8 to 12 tons per acre, and much of this was of a rather poor grade. The offbarred cane suckered well, and the suckers grew well and were not nearly so badly injured as those growing on the other cane. Mr. Leche, at St. James, put in a few acres of cane in the fall of 1904, but will plant most of his cane in the spring. This will give him opportunity to thoroughly clean the stalks and also to stir the soil in the spring and disturb the beetles that are hibernating or the pupæ of those not yet fully developed. No fall cane was put in on one large plantation at Broussards, while at most of the other places visited the planters have planted as much cane this past fall as the season would allow.

It is the custom on many plantations to allow the trash to remain on the field as it falls from the knives at the time of cutting. This is plowed under, either in the fall or the next spring, and the plant cane thus gets the full benefit. It serves, however, as an admirable hiding place through the winter for all kinds of insects that are present in the fields, and even when plowed under serves the same purpose for other insects that prefer to go beneath the soil for winter.

It is the general practice to follow stubble-cane with corn. Some planters, however, are still attempting to run stubble-cane for two or three years before making the change. Cornfields that follow second or third year stubble suffer a much greater percentage of injury than those following only first-year stubble. Where plant-cane was injured badly it was found that the cane had been laid in the same rows that were in corn the previous year, the furrows being cut out down the corn row, the canes laid in, and then dirt, stubble, and trash turned back over them. In any of the plans used, there is bound to be more or less trash buried with the cane at the time of planting, and often three successive layers of decaying vegetable matter are found, the two lower of which are scarcely disturbed throughout the year. It will readily be seen that this affords an ideal place for the breeding of white grubs of all kinds, as well as the larvæ of several other insects.

The headlands and roadsides in the fields almost invariably contain grass sod, sometimes sufficient to enable quite a cutting to be made for hay. In this sod were found the larvæ of several species of white grubs, wireworms, and rootworms, all of which are injurious to corn or cane in either the larval or adult stage or both.

It would appear that some such simple remedies as the following would materially aid in reducing the ravages of these insects, especially that of the sugar-cane beetle: Clean culture of headlands,

ditch banks and roadsides; burning off in the fall of all trash on stubble field—both corn and cane ground; thorough cleaning of cane before planting; running no second or third year stubble, and offbarring stubble-cane as late in the spring as the weather will allow.

Hand-picking of the beetles in the spring was quite successfully employed by one planter. Children were paid small sums to follow the "hoe gangs" and plows and pick up the beetles turned out.

While further studies on the life history and habits of this insect are necessary and desirable, there are some points in its control which will readily be evident. One of the most important of these is the disturbing of the grubs in the ground after freezing weather sets in. Rather deep fall plowing will turn them out and kill many, and if this is followed by a heavy harrow many more will be destroyed. Planters in almost all the districts visited have stated that this would also be of advantage to the soil.

REPORT ON A MEXICAN COTTON PEST, THE "CONCHUELA."

(*Pentatoma ligata* Say.)

By A. W. Morrill.

INTRODUCTION.

A report reached the Bureau of Entomology in March, 1904, to the effect that a considerable falling off in the cotton crop for the season of 1903, on a large plantation in the Laguna district of Mexico, was believed to be due to the work of an insect. It was desired that the matter be investigated by this Bureau, owing to the possibility of obtaining information of value in connection with the study of cotton pests in the United States. The writer was consequently detailed to visit the plantation, the headquarters of which are at Tlahualilo, State of Durango, Mexico, and to ascertain if an insect was concerned in the reduction of the yield of cotton for the previous season.

At this plantation can be seen probably the most extensive continuous cotton fields in the world, covering from 25,000 to 30,000 acres of land very nearly level, and comprising a portion of an old lake bed, with fine alluvial soil, the great fertility of which would be almost entirely unavailable but for water which comes through irrigation ditches from the Nazas River, some 40 miles distant. Surrounding the many thousand acres of cultivated lands is a desert, the principal vegetation of which consists of scattered mesquite trees. At the time of the writer's first visit (March 7 to 10) there was absolutely no green vegetation on the estate, except a few cactus plants in the outlying uncultivated portions, thousands of poplar trees growing along the banks of the irrigation canals, and a few ornamental trees and shrubs growing about the offices and living quarters of the managers.

The decrease in yield per acre of *planta* (planted) cotton[a] on this plantation for the season of 1902–3 as compared with the average yield per acre amounted approximately to one-third bale, or a total in round numbers of 6,000 bales. The resident manager of the plantation ascribed a considerable part of this difference to lack of water for irrigation at the most advantageous times on certain parts of the estate. In the cotton fields an examination of various portions indicated that fully 10 or 15 per cent of all the bolls had been rendered valuless by some agency. A conservative estimate would place the loss on this plantation at between 1,200 and 1,500 bales. The resident manager of the plantation believed this injury to the bolls to have been caused by a bug which occurred in abundance on the cotton plants the previous season. Fragments of several pentatomid bugs found among the fallen leaves under the cotton plants were identified by Mr. O. Heidemann as *Pentatoma ligata* Say. The injured bolls showed no boll weevil attack and less than 1 per cent of injury which could be traced to the bollworm.

Specimens of the insect believed to have caused the injury during the previous season were sent to the writer in July, and an accompanying letter from the resident manager stated that the bugs had appeared in the cotton fields for the first time in the season. It was impossible, however, to again visit the locality until several weeks after these specimens were received. The second visit to Tlahualilo was from August 30 to September 8, 1904, and it was during this period that the observations recorded in this paper were made on the life history and habits of the insect believed by many to have occasioned damage to the cotton crop of a single plantation amounting to many thousands of dollars.

HISTORY.

The species is known to the natives of Mexico, more especially in the northern part of the country, by the name of "conchuela," a Spanish word, meaning "little shell." That this species should have received a common name and that it should be so generally known among the cotton growers and laboring classes in the leading cotton-producing district in Mexico, indicates in itself that it has long been a common pest in the cotton fields. The species was first described in 1831, but, while mentioned in entomological literature several times since, the writer is unable to find mention of it as a pest,[b] except for a few

[a] The yield of seppa, or *zoca* cotton as it is known in the Laguna, is not here considered, as it receives only surplus water varying in amount from year to year.

[b] Doctor Fitch referred to what he supposed to be this species feeding on juniper and grape in New York State, but it seems probable that his insect was *P. juniperina* Linn. See footnote, page 20.

allusions to it in the newspapers in the summer of 1904 as being destructive to cotton in Mexico. Several specimens of *Pentatoma ligata* were received by this Bureau in August, 1902, from Doctor Dugés, taken at San Pedro de la Colonia, Coahuila, Mexico. The labels bear the inscription, "Injuring cotton."

DISTRIBUTION.

The original description of *Pentatoma ligata*, by Thomas Say,[a] was based on a specimen from Missouri. Uhler[b] notes that the species occurs in Missouri and Texas, doubting the statement of Fitch[c] that it occurs in New York. Herrich-Schaeffer[d] described what is now generally considered Say's species under the name of *Cimex rufocinctus*, from specimens from Mexico, and Kouchakevitch[e] described specimens from "Russian America," under the name of *Cimex rufomarginatus*, which Van Duzee[f] places as a synonym of *P. ligata*. Smith[g] records *P. ligata* Say as occurring, though "rare," at Caldwell, N. J. Van Duzee[f] says of the distribution of this species: "*P. ligata* ranges from Mexico northward through the Rocky Mountains to Vancouver Island, and apparently still farther north to Alaska."

In the collections of the Bureau of Entomology and of the United States National Museum are specimens bearing locality labels, as follows: Pecos, N. M. (Ckll), July 17, 1903; Los Angeles, Cal. (Coquillett); Arizona; San Diego, Texas (Schwarz); Abilene, Texas (Morrill), Nov. 8, 1904; Tlahualilo, Dgo., Mexico (Morrill), Sept. 3, 1904; San Pedro de la Colonia, Coahuila, Mexico (Dr. Dugés), Inj. cotton, Aug. 12, 1902.

DESCRIPTION.

The egg.—Diameter about 0.9 mm. and height about 1.2 mm. There are three distinct parts of the egg which may be termed body or lower part, neck or intermediate part, and the lid or cap. The last-named portion usually remains attached by a hinge after the hatching of the young. The body, the height of which is about two-thirds

[a] Description of New Species of Heteropterous Hemiptera of North America, 1831.

[b] Say's Entomology of North America, Vol. I, p. 315.

[c] The following references to *P. ligata* by Fitch and subsequent writers seem to refer to *P. juniperina* Linn.: Fitch, Ann. Report N. Y. State Agric. Soc., No. 3, p. 389, No. 4, p. 748; Packard, Guide, p. 546, 1869; Glover, Manuscript Notes from My Journal, p. 30, 1876; Provancher, Petite Fauna Entomologique du Canada Hemipterès III, pp. 41–42, 1886; Lintner, Fourth Report State Ent., p. 25, 1888, Tenth Report State Ent., p. 432, 1895.

[d] Wanzewartigen Insecten, p. 94, 1839.

[e] Hor. Soc. Ent. Rossicae, Vol. IV, p. 99, 1867.

[f] Trans. Am. Ent. Soc., Vol. XXX, p. 41, 1904.

[g] Cat. Ins. N. J., p. 120, 1900.

of that of the entire egg, is subcylindrical, being constricted in the middle, rounded more or less at the lower end, and at the upper abruptly curving inward to meet the neck. The width of the neck on the side (dorsal) opposite the hinge of the cap is about one-sixth of the entire height of the egg, and on the ventral side about one-third as wide as on the dorsal side. On the upper margin of the neck are pure white blunt processes, numbering as a rule 22. The cap is subconical, diameter at base two-thirds of diameter of body of egg, height one-fourth or one-fifth the diameter of base, apex rounded or somewhat flattened. The appearance of the egg is affected by translucent and opaque areas, which seem to be due to the absence and presence of a coating of wax. The cap is translucent, except for the

FIG. 7.—*Pentatoma ligata*: *a*, adult bug; *b*, egg mass on leaves; *c*, egg just before emergence of nymph; *d*, egg at an earlier stage of development; *e*, egg from side, showing exit hole at top; *f*, egg closed. *a*, *b*, enlarged; *c*–*f*, greatly enlarged (original).

edge, and the neck is translucent, except for its upper edge adjoining the cap, the translucent edges of the neck and cap thus combining to make a distinct ring of pure white. The body of the egg is opaque, except for three or four small translucent areas, usually present on the side. When the nymph is nearly ready to hatch the translucent areas are quite dark. In some of the empty shells of the same batch of eggs the translucent areas remain clear, though not transparent, and in some they become yellowish. The entire chorion is closely and finely punctate, the punctures in the translucent parts being smaller than on the opaque parts. The eggs are deposited in compact batches in the hexagonal system, each egg, except those on the outside, being in contact with six others.

Nymphs.—As only three of the five nymph stages were observed and described by the writer, it has seemed advisable not to publish at this time a technical description of any stages except the egg and adults. A brief description follows, which will suffice to give a general idea of the appearance of the immature stages.

The newly hatched nymph appears to the naked eye entirely black, but under a lens the abdomen is seen to be very dark slate-colored, with light spots on the lateral margins and a pair of shining black tubercles at the middle of the second and third abdominal segments above. This stage is about 1 mm. in length and nearly as broad as long; the head is appressed, making the broadly oval outline almost unbroken; the dorsum is rounded, giving the insect the appearance of a minute turtle. The next two stages are much alike, with reddish or orange border on thorax and abdomen, thorax otherwise black, head black, abdomen sometimes entirely black, but more often dark violaceous with black punctures. The fourth and fifth stages—although as stated above not seen by the writer—are without much doubt characterized by a general black, violaceous, or olivaceous black color with a reddish or orange border to the thorax and abdomen as in the first three instars. Also reasoning from what takes place in other pentatomids, without exception as far as known the wing pads first make their appearance in the fourth stage as backward-curving extensions of the sides of the mesonotum, not reaching the posterior margin of the metanotum. In the fifth or last nymph instar of all pentatomids observed by the writer, including representatives of three genera, the wing pads extend to the middle or slightly beyond the middle of the third abdominal segment.

Adult.—The original description of the adult of *P. ligata* by Say is as follows:

> *P. ligata.* Dull olive green, external edge sanguineous.
>
> Inhabits Missouri.
>
> Body olive green, rather dull; confluently punctured; antennæ black; second joint rather longer than the third; thorax, lateral margin sanguineous passing to yellowish on its inner side; scutel at tip bright sanguineous; hemelytra sanguineous on the lateral margin nearly to middle, abdomen on the lateral margin from the middle to the tip sanguineous; beneath tinged with yellow on the pectus; feet greenish, yellowish at base.
>
> Length, eleven-twentieths of an inch.
>
> Presented to me by Nuttall as a native of Missouri. The edge of the head is not reddish.

The top of the head is more closely set with punctures than the thorax and is quite black in all the specimens I have seen; when there is an olivaceous or pale tinge it is scarcely noticeable. The basal joint of the antennæ is sometimes, but not always, pale. The eyes may be entirely black, or, as sometimes occurs, the outer rows of facets are olivaceous or more rarely slightly reddish. The under

side of the head is more or less pale or bright olivaceous. The lateral margin of the pronotum is acutely carinated. The ground color of the body above, while usually a dull olive green, may have a slight purplish tinge. Lateral margin of prothorax above and below and the basal third to the basal two-thirds of the costal margin of the wing corium varies in color from dull yellowish to bright crimson; among the specimens seen by the writer the brighter shades being the more common. The tip of the scutellum corresponds in color to that on the margin of the thorax. In some specimens the legs are entirely black, but in most specimens there is more or less greenish or olivaceous on the coxæ, trochanters, and bases of the femora. The lateral margins of the abdominal segments above and below are colored like the margin of the thorax. The wing membranes are fuscous. The venter is quite variable in color, sometimes almost black, but more commonly olivaceous. One specimen at hand exhibits distinct purplish spots at the base of the prothoracic legs, another with a very large olivaceous venter has a pair of large light-green spots, one on each side of the middle, on the venter of the second, and a pair on the venter of the third abdominal segment. In all specimens seen the stigmatæ are paler than the surrounding area and not black, as in *Cimex rufomarginatus* A. Konch., which Van Duzee places as a synonym of *P. ligata*.

The length given by Say, equaling about 14 mm., is within a fraction of a millimeter the average of ten specimens at hand, which range from 13 to 14½ mm. The greatest width of the prothorax in the same lot varies from 6.75 to 7.50 mm., averaging about 7.25 mm.

FOOD PLANTS.

Besides Doctor Fitch's mention of *P. ligata* feeding on grape and hemlock, which, as I have indicated in the footnote on page 20, probably refers to another species, I am unable to find any reference in scientific literature to the food plants of this insect. Specimens in the collections of the Bureau of Entomology and of the National Museum show it to have been taken on cotton at Abilene, Tex.; Tlahualilo, Durango, Mexico; and San Pedro de la Colonia, Coahuila, Mexico. Mr. John Conduit and others connected with the Tlahualilo Agricultural Company believe the insect identical with one which occurs in more or less abundance on mesquite trees, feeding principally on the bean. In confinement adults fed on stems of mesquite leaves and also on the berry of the China tree (*Melia* sp.). Immature insects have fed, in confinement, on leaves of hackberry and on fresh mesquite beans. It is probable that the species can subsist on a large number of plants, but prefers those with succulent stems or fruits. In September, 1904, examinations were made of corn in

fields at Tlahualilo, of weeds along the roadside, of the desert vegetation of mesquite (the beans being dry at this time) and cacti, and of ornamental trees and shrubs at the headquarters of the estate; but on none of these were the insects found.

SEASONAL HISTORY.

For the information concerning the seasonal history of the conchuela, here presented, the writer is indebted to Mr. John Conduit, who, owing to the immense tract of cotton grown under his supervision, gives particular attention to cotton pests, and in addition to personal examinations in the fields, encourages the "bosses" of the various parts of the estate to send in to the office specimens of insects taken on the cotton plant, with information concerning their abundance and injury. The "bosses" in their turn make personal examinations and send dozens of laborers into the various subdivisions of the estate to search for any particular insect concerning which information may be desired at headquarters. This system made it possible to obtain accurate information concerning the abundance of the pentatomid bug here considered.

In 1903 the conchuelas were abundant only during the month of July, and reached a maximum in numbers about July 20. Their first appearance was in the outlying districts, next to the mesquite, but they soon spread all over the cotton plantation, though they were more abundant in certain parts than in others. The insects disappeared early in August and did not reappear in noticeable abundance during the season, although the cotton plants remained green until the 17th of October, when the first frost occurred.

Although a constant watch for the insect was kept during the late spring and early summer of 1904, the first specimen was not taken in the field until July 6. Several specimens were soon after this forwarded to me at Victoria, Tex. During the following seven days a rapid increase in their numbers was noted, causing considerable fear lest they seriously damage the cotton crop. On July 17, however, it was observed that a marked decrease in their numbers had occurred. Nowhere on the estate were the insects as abundant as in July of the previous year, nor were they so generally distributed. On August 31, the date of my first examination in the cotton fields on my second visit to Tlahualilo, the insects were so scarce that but five specimens were found during the first search of one and one-half hours. They were afterwards found in somewhat greater abundance in another portion of the estate. No nymphs and only a single batch of eggs could be found in the field, this latter having been deposited in a field cage. Several hours each day for nearly a week were spent in the cotton fields before any adults were seen in coition. During this period many adults were seen at different times of the day. In the

afternoon of the seventh day of these observations a male was observed courting a female, and later in the same afternoon, in a brief stop in a field, two pairs of the bugs were seen copulating. During the last three days spent in investigating this insect many pairs were found mating. The reason for the reappearance of the mating instinct was not apparent. Messrs. Conduit and Vaughan, both in the employ of the Tlahualilo Company, assert that five or six weeks earlier in the season the adults were frequently seen copulating on the cotton plants.

LIFE HISTORY AND HABITS.

ADULTS.

Methods.—Owing to the scarcity of the bugs during the investigation and to the ease with which they can be detected when present, the plan of tagging bolls and plants in the field and making records twice a day, was found to give good results. Some observations were made with adults in confinement in tumblers, and with others confined in large wire screens in the fields.

Feeding habits.—The adults seem to be able to detect food from a distance, though this point was not definitely determined. In each of three cases when an adult escaped from a cage out of doors in a field where the plants were widely separated, it was afterward found on the plant nearest in its direction from the cage; in other words, the bugs did not pass over or near any other cotton plants in going to the plant upon which they were found.

In confinement, the adults fed on the fruit of the China tree and twigs of the mesquite tree, as well as upon cotton bolls. Five adults left in a glass with a two-thirds grown bollworm for six hours showed no carnivorous tendencies.

Although the adults feed upon all parts of the cotton plant in the field, the bolls are much preferred to the stems and leaves. Fifty-seven field records show the total number of times the bugs were recorded as feeding on bolls to be 43; on leaves, 4; on stems, 10. The bugs were recorded resting on bolls in the field ten times; on the leaf, once; and on the stem, once. The bolls are undoubtedly preferred on account of the rich juice of the seed which the insect is able to reach (except probably in the older bolls with well-matured lint) by means of its mouth setæ. The examination of many bolls shows that the immature seeds are the objective points of the insect's attack. A preference is almost invariably shown for bolls growing near the tops of the plants.

In feeding on the cotton plant, the adult generally occupies a conspicuous position, especially when on a boll. The writer has never found them inside the bracts of a square, and when on a boll, never entirely hidden by the bracts.

When feeding upon a cotton boll the mouth setæ do not remain

in the usual position in the groove of the rostrum, but the insect, after inserting the setæ into the tissue of the plant, either folds the rostrum directly back, freeing the setæ entirely from it, or doubles it up in the form of the letter "Z," the upper angle representing the joint between the first and second, and the lower angle that between the second and third segments. At the latter joint the setæ remain in the groove. When feeding, the bug constantly raises and lowers its head. When the setæ are entirely withdrawn from the boll, the spine, located on the inner side of a fore tibia slightly beyond the middle, is used to replace them in the rostral groove. The setæ are pressed into place by one stroke of the tibia.

These insects have been observed to feed upon a cotton boll for ten minutes without withdrawing their setæ. One adult under observation in the field visited four bolls, two on each of two plants in two days, and remained for over thirty-six hours on the last of the four bolls. Another adult bug remained on the same boll for two and three-fourths days. Three remained on the same plant for over thirty hours, and three others were found on the same plant thirty-two hours after they were first recorded. In none of these cases was it known how long the insects had been on these plants previous to their being first noted. They do not always remain so long, but have been observed to alight for but a few minutes on a cotton plant and then fly to another without feeding.

In cages in the field during the middle of the day the insects are more restless and are more frequently seen crawling about on the screens; after sundown they are usually found quietly feeding.

Flight.—When liberated in a room the adults fly readily and invariably nearly straight toward the light. In the field their direction of flight is usually curving and the greatest distance obtained in any of six flights observed and recorded was 25 feet. In four successive flights from the hand, held at a height of 4 feet from the ground, an adult female covered on an average 15¾ feet per flight. An adult male, apparently in normal condition, taken when feeding on a boll, in attempting to fly from the hand dropped directly to the ground. It is probable that these records are not indicative of the distance which these bugs are capable of flying when newly matured.

Gregariousness.—It very frequently happens that more than one conchuela is present on a plant, even though no others can be found on plants for a considerable distance in any direction. The belief that this gregariousness is not due to the adults found on a plant having developed from eggs laid on that plant is supported by the fact that careful search failed to reveal the remains of the egg batch, by the fact that adults under observation did not remain on the same plant in any case for as long as three days, and also by the frequently noted occurrence of two or three adults appearing at nearly the same

time on a plant which had been free from the insects, as shown by examinations for two or three previous days. The following is the record of 34 specimens of *P. ligata* collected in the cotton fields. Each record refers to collection from a single plant when none could be found on near-by plants: August 31, 2; September 1, first plant, 2, second plant, 3; September 2, first plant, 3, second plant, 1; September 3, first plant, 2 (male and female), second plant, 5 (3 females, 1 male, and 1 escaped); September 3, first plant, 1, second plant, 1, third plant, 2; September 4, first plant, 1, second plant, 2; September 6, first plant, 3, second plant, 2, third plant, 3, fourth plant, 2. The average number of bugs per plant in the instances recorded above was 2¼. In addition to the instances where two or more were found on a single plant, it might be mentioned that not infrequently after searching for the insects without results one is found on each of the two adjacent plants, while, as in the case for single plants referred to above, none could be found on any other plants near by. To determine whether this gregarious tendency is due to sexual attraction or to sight would require more careful attention than it was possible to give on the occasion on which these observations were made.

Egg laying.—All of the eggs of *Pentatoma ligata* which were obtained were deposited by females in confinement. They were deposited in batches of from 18 to 43 eggs. One batch was deposited on a mesquite leaf, the others on the bracts of cotton bolls and on cotton leaves. It is believed that three and possibly four batches were deposited by the same female. The three batches probably deposited by the insect referred to numbered together 107 eggs. A female pentatomid bug of another genus (Podisus) has been known to deposit nearly 500 eggs, a fact which not only gives weight to the supposition that these 107 or more eggs were deposited by the one specimen of *P. ligata*, but which indicates that this number does not necessarily give an idea of the maximum number a single female may deposit.

EGGS.

The following table shows the duration of incubation and the approximate number hatching under indoor conditions, the last four batches being kept most of the time in small pill boxes:

Egg laying, incubation, and hatching.

When deposited.	Number of eggs in batch.	When hatched.	Number hatched.	Period of incubation.
				Days.
September 4	43	September 10	21	6
September 6	18	September 14	[a]6	8
Do	39	do	24	8
September 7	28	September 15	14	8
Do	40	do	21	8

[a] Eleven eggs became separated from the batch and were lost before any of them hatched.

The average period of incubation, as shown by the above figures, is nearly seven and a half days under the conditions noted.

NYMPHS.

For several hours after hatching the young nymphs remain closely clustered upon the top of the egg batch, with scarcely any perceptible movement. In all cases where the eggs of this species have come under the writer's observation, less than two-thirds of the total number in the batch have hatched, although those which failed to hatch contained nymphs. It was found that, as in many other species of pentatomids, the nymphs of the first instar which first hatch begin to feed, after a few hours' quiescence, upon the contents of the unhatched eggs. It is not impossible that some or all of the nymphs thus fed upon were already dead. Some of the nymphs which have been observed obtained enough food from the unhatched eggs to pass through the first instar. Others became quite plump by feeding upon the eggs, but fed readily upon fresh cotton leaves when placed upon them. The first molt occurred the seventh day after hatching, and the second molt on the third and fourth days after the first. It was impossible to give the young insects the attention necessary to breed them to maturity, and all of them died before molting a third time.

INJURY TO COTTON.

Injury to Cotton at Tlahualilo in 1903.

As stated in the introduction, it was estimated after a personal examination of the dry stalks in the cotton fields at Tlahualilo on March 8, 1904, that an average of 10 to 15 per cent of the cotton bolls were injured by some agency to the point of worthlessness. The nature of much of this injury was found to be, to all appearances, identical with that resulting from the attacks of the conchuela, as observed in fields of growing cotton at Tlahualilo from August 30 to September 8. Concerning some of the bolls, there was more doubt as to the cause of the injury, which consisted in the locks dying after reaching a late stage in their development. The opened bolls showed more or less stained fibers remaining closely matted together, and at the extreme tip noticeably shriveled. In consideration of the possibility that this injury was due to a vegetable disease, dry specimens were submitted to Dr. A. F. Woods, pathologist and physiologist of the Bureau of Plant Industry, with a request that they be examined for evidence of trouble of this nature, but it was found that no fungous disease could have been responsible for their condition. There being no evidence of a disease of a bacterial or physiological nature, there is but little doubt that the condition described above is due to

injury by heteropterous insects, principally by the predominating species in this particular locality, *Pentatoma ligata*. The difference in the nature of the damage produced can probably be explained by the difference in the degree of development attained by the bolls before they receive the first injury.

Injury to Cotton at Tlahualilo in 1904.

At the time of the second visit of the writer to Tlahualilo it was possible to obtain more definite information concerning the character of the injury caused by the conchuela. This was done principally by means of tagging in the field cotton bolls known to have been fed upon more or less by the insect.

External evidence of injury by this bug never appears, except when a boll is fed upon when very small and one or more locks are injured, so that growth ceases in the injured portions and a deformity of the boll results. The inner side of the carpels of green bolls which have been fed upon by the conchuela show a minute dark spot, indicating the point at which the seta entered, and surrounding this may be an abnormal wart-like growth which is of more frequent occurrence in small bolls, or a smooth circular area which becomes dark green and contrasts sharply with the lighter background. Large bolls nearly mature have been examined with as many as twenty-five or thirty of these spots, but with uninjured seeds, these probably having been protected by the resistance of the lint to the entrance of the insect's mouth organs. This difficulty probably increases with the increasing age of the boll. In examining smaller bolls it was found that a single spot on the inside of the carpel was good, though not positive, evidence of injury, which could be seen only by breaking open the developing lock. In fields where no bugs of any kind could be found none of the bolls showed these spots, while in every case a certain injury to seeds and surrounding lint, which I learned to ascribe to *P. ligata* and a few less common species of heteroptera, was accompanied

Fig. 8.—Supposed work of *Pentatoma ligata* on cotton boll (from photo by W. E. Hinds).

by one or more of these spots directly opposite on the inner side of the carpel.

The conchuela usually inserts its mouth setæ through the carpel and developing lint into the seed. An injured immature seed at first is characterized by a watery appearance, later it takes on a brownish color and appears decayed, finally shriveling. Two or three days after the seed is injured by the feeding of the bug, the surrounding lint becomes slightly discolored. If only a short time was spent in feeding upon the seed of a nearly matured boll, the injury consists simply in a yellow staining of the lint, but if the boll be less than two-thirds grown the injury is likely to be more serious. The decayed appearance then spreads throughout the lock, which shrivels and is spoiled. The observations thus far made show that a bug must spend at least several hours to destroy the usefulness of a lock of a cotton boll instead of only the few minutes necessary to deposit an egg, as is the case with a female boll weevil.

Several observations were made in the field to establish the connection between the conchuela and the injury described above. A few of these will be outlined. Bug No. 1 was found on a plant upon which it remained for over twenty-four hours, it being unknown how long it might have been on the same plant previous to discovery, or how many, if any, other bugs had been present. On examination of the unopened bolls it was found that there were uninjured 5, slightly injured 1, badly injured 6. Two opened bolls were uninjured. As a check for this plant, the bolls on the next one in the row were examined, and of the 12 unopened and 3 open bolls all were perfect. This same insect moved 4½ feet to another plant and was found upon the same boll at each of the several visits to the field during the following thirty-six hours. The insect then disappeared and was not afterwards found. An examination of the 15 bolls on this second plant showed only 2 injured ones, the one on which the bug was known to have fed for thirty-six hours, which was badly damaged, and another the injury to which was apparently caused by a bacterial disease of the nature of anthracnose.

On September 4, 1904, at 11.45 a. m., two specimens of *P. ligata* were found in the cotton field on a plant, surrounding which for at least 50 feet in all directions were plants which after careful search were found to be free from the insect. Six hours later two more adults were found on this plant, an examination as before showing the surrounding plants to be free. Two days later the plant under observation was entirely free from the insects, and on September 8 all the bolls on the plant were opened and each lock was examined. Of the 15 bolls 7 were badly injured; 4 (3 of which were produced on the lower branches close to the ground) were perfectly sound in every way. As a check, an examination was made of the 16 bolls on

a very similar plant standing 3 feet away in the same row: 14 of these were perfect in every way, 1 boll was injured by a boll worm, and the remaining injured boll had the appearance of having been fed upon when quite small by *P. ligata* or some other heteropterous insect. One lock of this boll was decidedly stunted, giving it a deformed appearance. The inside of the carpel of the stunted portion showed the characteristic mark of injury already described, as did several seeds with the surrounding lint.

On September 8 an examination was made of the bolls of a plant upon which three specimens of *P. ligata* were taken on September 6. As before, the surrounding plants were free from the insects and their bolls only in few instances showed injury of the nature described as occasioned by this species. Of the 64 bolls over 1 inch in diameter which were on the plant, 20 were selected at random and carefully examined, and but 2 of them were found to be uninjured.

As the above observations might lead to an exaggerated idea of the injury believed to be caused by the insect here considered, it should be explained that in the field where the above instances occurred the conchuelas at the time were more abundant than elsewhere on the plantation, and even here (with the exception of a limited area) on not more than 5 or 6 stalks to an acre could the insects be found. The observations indicate, however, that when they are very numerous the conchuelas are capable of causing considerable damage to the cotton crop.

The exceptional area referred to above consisted of about 300 square feet in the cotton field, which was slightly lower than the general level. The plants were consequently growing more vigorously, and more adult conchuelas were found at work here than elsewhere. An examination of all the bolls over 1 inch in diameter on 10 representative stalks showed that 33 per cent of them were injured, and of the open bolls on these plants 19 per cent had at least one lock damaged by shriveling, apparently caused by the attack of a heteropterous insect.

As a check to this examination, 30 bolls, from one-third to three-fourths grown, were examined on a portion of the plantation which was remarkably free from insects, and where no heteropterous insects of any kind could be found. Each lock in each boll was carefully examined as before, with the result that only 2 bolls were found to show the slightest internal discoloration, and this did not extend to the seed, nor was it accompanied by the spot on the inside of the carpel, which the evidence obtained showed to result from the puncture of *P. ligata*.

Cage experiments were conducted for the purpose of learning how long after a boll is fed upon the injury becomes apparent and also how long feeding must be continued to work an injury. Neither

of these points was satisfactorily determined, owing to the brief period available for this investigation. As has been stated, the size of the boll is an important factor; probably a single bug in a few hours, or perhaps minutes, can produce an injury to a boll one-fourth or one-third grown which will prevent its developing perfect lint. On the other hand, it seems that after the lint reaches a certain degree of development, perhaps when the boll is about three-fourths grown, it is beyond the limit of danger of serious injury from the conchuela. The following records show the only information obtained from the cage tests relating to the question of how long after being attacked, the injury to the boll appears:

Results of cage tests with Pentatoma ligata, 1904.

Cage No.	Number of bugs.	Apparently sound bolls.	When caged.	When examined.	Injured bolls.	Severely injured bolls.
1	5	8	September 3	September 7	4	2
2	6	26	September 4	do	16	0

The cage tests were made in a portion of the plantation apparently free from the conchuela and other bugs, and where no injury to bolls could be found which was likely to have been caused by such insects.

Relation of Mesquite to Infested Fields.

The conchuela is believed by Mr. Conduit to be identical with an insect which breeds upon mesquite beans.[a] In the early summer of 1903, owing to specially favorable weather conditions the crop of mesquite beans was unusually large, and it is generally believed in the Laguna district that an unusually large number of the conchuelas developed in the mesquite, and upon the maturing and drying of the beans the insects made their way into the cotton fields in correspondingly large numbers. Both of the writer's visits to Tlahualilo, made at times when there were no green mesquite beans, and no specimens of *P. ligata* could be found in the mesquite or anywhere else except in the cotton fields, nor could any remains of their immature stages be found, except a batch of eggs from which the nymphs had emerged, which was found on the ground among the dead leaves on March 8.

Although no direct evidence could be obtained concerning the origin of the large numbers of the insects which infested the cotton fields in 1903, the statements of Mr. Conduit concerning the portions of the estate where the insects occurred in greatest numbers, both in 1903 and 1904, seem to show a connection between these portions and the parts of the uncultivated land surrounding the estate on all sides, upon which the mesquite growth was most abundant.

[a] Since the above was written this has been verified by the writer.

INJURY TO COTTON AT TLAHUALILO, MEXICO, BY OTHER HETEROPTERA.

The injury to cotton by *P. ligata* is probably the same as might result from the attacks of many other heteropterous insects. Several species of pentatomid bugs were collected feeding on cotton bolls, but none were numerous enough to cause appreciable damage. Next to *P. ligata*, the most abundant heteropteron found feeding on cotton bolls was *Leptoglossus zonatus* Dall. The injury found on the examination of bolls upon which bugs of the latter species had been feeding I was unable to distinguish from that resulting from the feeding of the former. The individuals of the above coreid were not common enough in the cotton fields during the first few days of September to interfere with observations on the conchuela. The following heteroptera, in addition to the species above mentioned, were found on cotton at Tlahualilo between August 31 and September 8, 1904. For their identification the writer is indebted to Mr. O. Heidemann, of the Bureau of Entomology: *Apiomerus spissipes* Say, *Zelus renardii* Kol., *Largus cinctus* H. S., *Oncopeltus fasciatus* Dall., *Murgantia histrionica* Hahn, and *Thyanta perditor* Fab.

INJURY BY THIS AND OTHER PENTATOMIDS IN THE UNITED STATES.

The species here considered has been taken on cotton in our own cotton States, but neither it nor any other pentatomid has ever, so far as the writer can learn, proved of much consequence as a pest in the cotton fields. The eggs of pentatomids are attacked by several hymenopterous parasites, which probably more than any other factor prevent many of the species from becoming serious pests. Occasionally, however, we find reports of a species of this family, previously unknown except, perhaps, for a scientific description, springing suddenly into prominence as a pest in one locality or another and the following season becoming of the same slight importance as usual. An instance of this kind is briefly mentioned in a previous bulletin of this Bureau,[a] *Pentatoma sayi* Stål being there referred to as appearing as a serious wheat pest in Colorado, Arizona, and New Mexico in the summer of 1903. Many pentatomids and other heteropterous insects, which probably all cause damage to cotton similar to that of *P. ligata*, occur in the cotton fields in this country. It is possible that this species may be sporadically of more or less importance locally, especially under circumstances where, by the unavoidable losses occasioned by the boll weevil, the small margin of profit makes it necessary to reduce to the lowest practicable limit injuries from the minor pests. Assuming the truth of the report that this species breeds upon mesquite beans, it is evidently much more likely to

[a] Bulletin No. 44, Division of Entomology, p. 86.

appear in cotton fields in injurious numbers in such irrigated districts as the Laguna of Mexico, where, when their chief food supply in the desert becomes unfit for them, they are driven to the cotton plants from necessity, there being almost nothing else available for food. In other localities the insects might become widely distributed among various crops and only small injury be done to any one of them.

SUGGESTIONS FOR CONTROL.

As these insects in the cotton field almost invariably occupy a conspicuous position on the cotton plant, usually on a boll, there is little trouble for even an inexperienced person to find them when present. Their habit of segregation is of much importance in this connection. Whenever they become abundant enough to deserve attention from the cotton grower, hand picking, or knocking into collecting pans containing oil, will probably be preferable to spraying with contact insecticides, the value of the former depending in a measure upon the availability of cheap labor. Clearing up the fields in the fall, destroying both the cotton stalks and the weeds surrounding the fields by burning, would prevent, in a large measure, the hibernation of this, as well as many other cotton pests, and constitutes a practice the adoption of which by all cotton growers is strongly urged by economic entomologists. It may be advisable under some circumstances to provide for the treatment of the conchuelas on mesquite trees when it is found that they are developing thereon in threatening numbers, and when experience shows that these trees growing close to cotton fields are an element of danger, it might even be good policy to remove them entirely.

THE SUGAR-BEET CROWN-BORER.

(*Hulstea undulatella* Clemens.)

By E. S. G. Titus.

While investigating the general insect enemies of the sugar beet the past season (1904), the writer found at Waverly, Wash., Echo, Oreg., and Spreckles and Oxnard, Cal., evidences of an injury to sugar beets that could not be traced to any insect at that time occurring in the fields. The injury at these places was quite local, usually occurring in small patches over some of the fields, and was most noticeable on the richer soils. The beets had been injured earlier in the year and their growth practically stopped. Some of the tops had lived on for some time, but had eventually dried down. When these were lifted only a small portion of the beet usually came with them, and this a rather ragged portion of the crown. Digging into the soil, the remainder of the root could usually be found, shriveled and dried up, but rarely showing marks of injury.

Vacant spaces could be seen extending sometimes 10 or 15 feet down a row and covering an area from 2 to 5 rows wide. Those few injured beets that had survived the attack were dry, almost lifeless, the leaves being small and the root of no value.

Upon reaching the Santa Ana Valley and neighboring beet regions in southern California, especially at Chino, the work of this insect became more common and the damage in places was quite severe. The owners attributed the loss to plant lice and cut worms, but a very slight examination was sufficient to show that the beets had been attacked by some borer, and that work on them was still in progress. At Huntington Beach, near Los Angeles, and at Chino, the larvæ causing the injury were found in several fields, and at the latter place moths, which later proved to be the adult form of this phycitid borer, were rather common in one field on the beet-sugar company's ground.

From examination of the beets it is evident that the young larva at first works on the beet just below the bases of the leaves, eating through the outer skin and either boring directly into the beet or working its way around the crown beneath the epidermis, thus making a swollen line that has the appearance of a mine, often much like early work of *Pegomya vicina* and similar species mining in leaves. As the larva grows in size it forces its way farther and farther into the beet until it reaches the center, when it may bore directly downward or pass on through the beet and then return and feed up and down inside the root. In all the galleries examined I found more or less evidence of a silken tube. Those of the older larvæ that were feeding on the outside of the beet had constructed tubes covering their operations and protecting them from contact with the soil. Sometimes these tubes extended for a considerable distance away from the beet. These tubes are very fragile, and not nearly so firm in construction as those made for hibernating purposes by the sugar-beet webworm (*Loxostege sticticalis*).

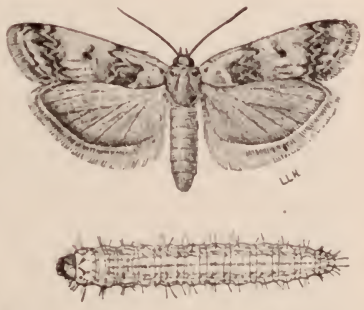

FIG. 9.—*Hulstea undulatella:* adult and larva—enlarged (original).

Several larvæ were usually found attacking a single beet, and, from the fact that tubes were found extending from beet to beet down the rows, it is probable that the larvæ after killing one beet may pass on to another one in which they will complete their growth. Pupæ

were usually found in the tubes outside the beets, but a few pupa cases were noticed in the burrows.

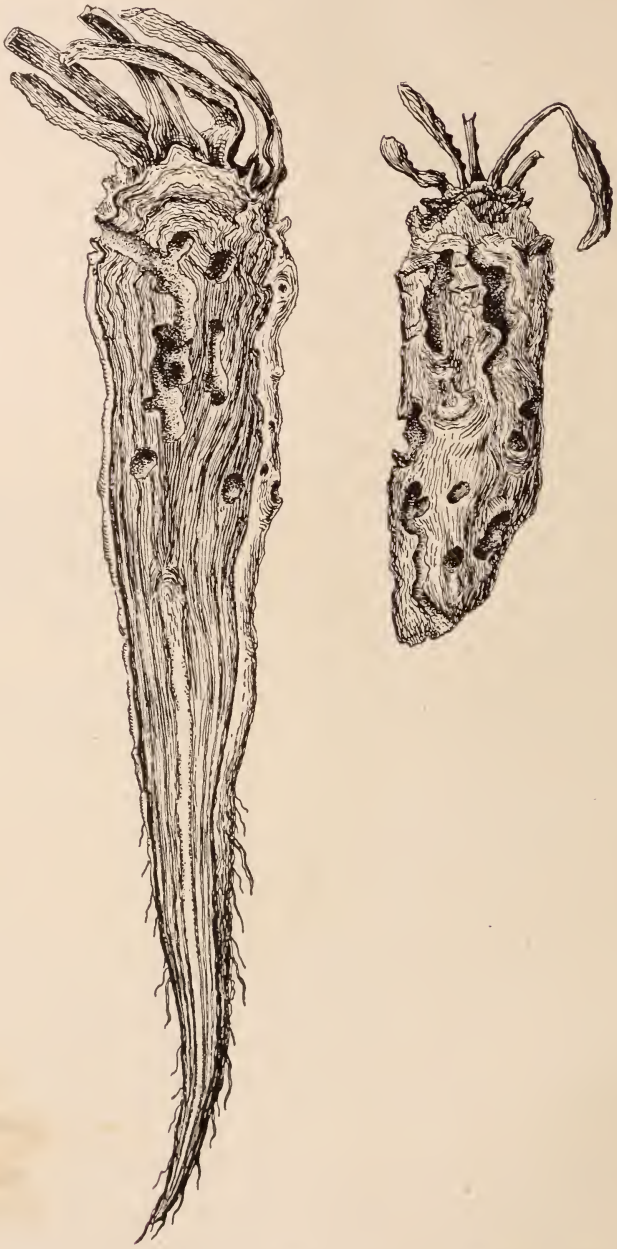

FIG. 10.—*Hulstea undulatella:* longitudinal section of beet and small beet showing injury—natural size (original).

There are apparently two broods of this insect, eggs being laid in early spring upon the young beets and the adult appearing in June or July, when the second brood eggs are laid. The larvæ of the second brood develop and become full grown in the fall, and probably most of the adults emerge at this time, although two of the larvæ taken last October are still (April 1) in that stage in our breeding cages. It may be that in southern California the adult emerges in the fall and lays eggs on some native food plant. Adults were quite common in that region in late September, especially in the early evening before dark. They would fly quickly when disturbed, but only for short distances, and usually alighted on the under side of beet leaves or on the ground, the color of which they closely resemble. Some minute white eggs were found at the bases of leaves of beets, which may belong to this species or to the tortricid mentioned below.

This moth has a wide distribution, having been taken in many parts of the United States. Specimens in the National Museum bear labels from the following localities: Maine (Packard); Massachusetts; New York (Burnett); Anglesa, N. J., June 23 (Kearfoot); Hastings, Fla., April (Kearfoot); Wisconsin; Stockton, Utah, numerous specimens, dates, June 24, 29, August 4, 6, 7, 8, 11, 23, and September 1, 8, 11 (Tom Spalding); Denver, Colo., May 1, 15, and September 15; Pueblo, Colo., July (Kearfoot); Pullman, Wash. (Piper); Kaslo, British Columbia (Dyar & Caudell); San Francisco, Santa Clara, and Alameda, Cal. (Koebele); Williams, Ariz., July 7, 10, 23 (Schwarz & Barber); Flagstaff, Ariz., July 8, 24 (Barber); Sapello Canyon, N. Mex. (Oslar). The species was described by Clemens[a] under the genus Nephopteryx in 1860 from specimens "From Dr. Charles Girard, Washington, D. C., Pennsylvania, Canada, and Massachusetts."

FIG. 11.—Upper portion of beet injured by *Hulstea undulatella* (original).

The statement that the insect was reared from elm, which has

[a] 1860: Clemens, Proc. Acad. Nat. Sc. Phila., p. 205.

several times been accredited to Clemens, has very little foundation. Following his description he says:

> Early in October I found the pupa of this insect at Niagara Falls, on the Canada side, under shelter of loosened portions of the bark of American elm. They were inclosed in a cocoon of silk, mixed with particles of bark. On the same tree I took a number of larvæ which were ascending the tree to undergo pupation. I did not, however, obtain imagoes from any of the specimens. The body was nearly uniform in diameter, with the ordinary number of feet. Head as broad as the body and dark green. Body dark green, between the segments yellowish and dotted with yellow; first rings with two black dots on the sides.

Doctor Hulst,[a] after giving the following localities for this species—"Canada, Massachusetts, New York, Pennsylvania, Illinois, Virginia, Texas, Colorado, Utah, California"—states that he has received it from Texas in August and September, and then quotes Clemens's remarks given above, but omits the important statement that *no specimens were bred to maturity*. The other published references to the species simply record it as feeding on elm, an error evidently derived from the original reference or from Doctor Hulst's paper.

Doctor Clemens's description of the larva he found does not accord with the larvæ taken on sugar beet, and from which specimens were bred that were identified by Dr. H. G. Dyar, of the United States National Museum, as belonging to this species. Our larvæ when fully mature were 16 to 18 mm. in length, head slightly narrower than first segment following; pale brown in color, darker on tip of clypeus and tips of mandibles, antennæ and palpi paler, almost yellow; body varying from pale green to dirty yellow, paler between segments, usually a single black dot on each side of the first segment; feet all tipped with black. The larva is very transparent, so that the internal anatomy is clearly visible.

The adult measures 12 to 16 mm. across wings when fully spread. Fore wings dark gray, varying to a pale gray, with traces of fuscous and black scales interspersed, a red spot usually present within the basal line, irregular dentate lines along outer margin are darker; hind wings dark fuscous, shading out darker on outer margin, fringe very pale; thorax with a dark spot on each side near front; abdomen varying from gray to almost black; antenna gray, half the length of the fore wing; palpi varying from white to brownish red, darker at tip.

Many of the larvæ or pupæ were parasitized. A dipterous parasite was identified by Mr. D. W. Coquillett as *Exorista pyste* Walk.

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[a] 1890: Hulst, Trans. Amer. Ent. Soc., v. 17, pp. 187–188.

(fig. 12). It bred from pupæ taken at Chino and Oxnard, Cal. This parasite was also reared from the pupæ of an unidentified tortricid found feeding on the leaves of sugar beet at the same places. Three species of Hymenopterous parasites were reared, but with the exception of the one noted below it was impossible to tell whether they were bred from larvæ or pupæ. They were identified by Dr. W. H. Ashmead, of the United States National Museum, as *Chelonus iridescens* Cr., *Spilochalcis torrina* Cr., and *Habrobracon hebetor* Say.

FIG. 12.—*Exorista pyste*—much enlarged (original).

Specimens of *Chelonus iridescens* (fig. 13), issued from pupæ of the crown borer in early October. This parasite is represented in the National Museum collections by specimens from Agricultural College, Mich.; Washington, D. C.; South Dakota; Colorado; Wyoming; Corvallis, Oreg.; Garland, Utah; Kukak Bay, Alaska; Easton, Wash., and San Diego, Cal. The last of these specimens (bearing the U. S. Dept. Agr. No. 797P[8]) was bred from a phyticid larva (or from the pupa) found feeding in the seed pods of *Aphyllon tuberosum*. This species is entirely black except the legs, which are marked with pale yellow; about 4 mm. in length; very rugosely punctured on thorax with longitudinal striæ on abdomen.

FIG. 13.—*Chelonus iridescens*—greatly enlarged (original).

But one specimen of *Habrobracon hebetor* Say was reared from the

crown borer; this issued October 5, 1905. This species has been reared from several of the flour and meal moths [a] in this country. A European species, *Bracon brevicornis* Wesm., is, as stated by Dr. Chittenden, quite probably a synonym of Say's species. It has been reared from two species of Ephestia and from lepidopterous larvæ in Europe. The species has black antennæ, head, and thorax; abdomen fuscous; leg more or less pale yellow; femora usually black at base; ovipositor of female black.

Spilochalcis torvina (fig. 14) was bred from the crown borer, and also from pupæ of the unidentified tortricid before mentioned from Chino, Cal., in early October. This dainty little chalcid is jet black, with many pale markings, though usually there is a brownish-red shading from white into the black; the abdomen is somewhat fuscous on the side beneath.

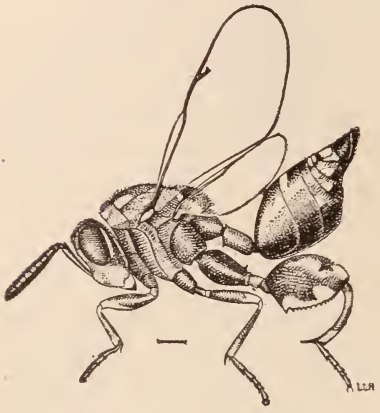

FIG. 14.—*Spilochalcis torvina*—much enlarged (original).

REMEDIES.

Cultural remedies tending to thoroughly disturb the soil at the time the larvæ are nearly mature and destruction of the beets showing injury will doubtless aid the control of this pest. It will complete the destruction of the injured beet, since the larvæ will in all probability breed out even if the beets are removed from the soil. A more complete study of the life history of the insect may show opportunity for other remedies.

THE DOCK FALSE-WORM.

(*Taxonus nigrisoma* Nort.)

By F. H. CHITTENDEN and E. S. G. TITUS.

September 5 and 6, 1904, the junior writer observed larvæ of this species of tenthredinid at Menominee, Mich., attacking sugar beet and a yellow dock (*Rumex patientia* or *brittanicus*).

The larvæ were feeding on the upper sides of the leaves, usually placing themselves parallel with the larger veins; often several larvæ were found feeding side by side, reminding one of colonies of the grape social caterpillar (*Harrisina* [*Procris*] *americana* Guer.). From 6 to 20 larvæ were counted on single leaves both of sugar beet and dock, and as many as 70 were taken from a single plant.

[a] 1897, Chittenden, Bul. 8, n. s., Div. Entom., Dept. of Agric., pp. 39–41.

They are quite active, readily curling up when disturbed and usually rolling down the leaf into the mass of young leaves at the base. It is interesting to note that larvæ were also active in confinement, but not easily disturbed, not curling up unless considerably agitated. This was doubtless due to the handling they had received in packing and unpacking and to the jarring incident to their long journey, all of which had the effect of causing them to be less easily disturbed than under normal conditions.

Dock was rather scarce in the field at this time, the beets having been recently cultivated, and their leaves at this season of the year so covered the ground that the young dock leaves had not had opportunity for growth. It is probable that the larvæ on the beet leaves had been hatched from eggs deposited on dock, and that they had

FIG. 15.—*Taxonus nigrisoma*: *a*, adult; *b*, larva; *c*, head of same; *d*, cocoon in stalk—all enlarged (original).

resorted to the former when the dock was cut down. Several beet plants were seen that had been seriously injured, and the dock leaves remaining in the fields were riddled. Dock plants growing along roadsides and in uncultivated fields were not infested. The larvæ seen showed a preference for leaves more or less protected by other leaves; they usually rest flat on the leaf, but some were noticed slightly curled when resting near the edges.

At this time the larvæ belonged to several stages, three at least, one being the mature stage.

DESCRIPTION.

Mature larva.—The prevailing color of the mature larva is leaf green, slightly paler than that of either of the leaves on which it feeds, this paleness being, perhaps, due to the presence of a faint

bloom on the surface. The larva is of the normal tenthredinid form, the surface not very strongly wrinkled, 6-annulate, smooth, and not shining; the head is pale, nearly white, or pale green tinged with brown, clypeus with a distinct brown spot, a brown band sometimes present above the clypeus, head usually darker on the upper third; eyes black, mouth-parts dark brown, tips of mandibles darker; the lateral surface, as well as the lower, varies from pale yellowish to pale but distinct green, this color extending from the line of the spiracles, the darker coloration of the dorsal surface often almost enveloping the spiracles; body slightly brownish in the folds; spiracles small, elongate-oval, black. Segment 13 is much paler dorsally than the remaining segments. Besides the three pairs of nearly white thoracic legs, which are more or less infuscated at the sutures, there are eight pairs of abdominal legs (segments 6 to 13), which are also pale. Length, 13 mm.; width, nearly uniform from the second thoracic to the antepenultimate segment, 1.5 to 2 mm.

Antepenultimate stage.—What appears to be the antepenultimate stage closely resembles the mature form, but is less greenish in color and has a proportionately larger head. In this stage, larvæ are pale green, with a somewhat irregular, ill-defined, broad, darker green space on the sides just above the spiracles; white piliferous tubercles, somewhat faint, but quite noticeable in living specimens, occur in this stage. Length, 10 to 11 mm.; width, 1.2 mm.

Younger stage.—A still earlier stage was represented by very few specimens and was very much darker. Dorsal surface pale brown, shading into black at the sides; piliferous tubercles distinct, large and white, arranged in regular sets; head almost uniformly dark brown. Length, 7 to 10 mm.; width, 0.9 to 1 mm.

Larvæ placed in a rearing cage in the insectary did not feed on sugar-beet leaves, but when dock was substituted fed until maturity. From these larvæ three adults issued September 24. Larvæ kept by the junior author with him on his trip westward were confined in a small tin box and fed on beet leaves. From these one adult issued October 3. The larva from which this adult came formed a naked pupa in the box September 23, and this pupa was kept wrapped in a beet leaf until the adult issued.

The pupa.—The pupa is at first pale green, with dark extremities and tips of feet and palpi brownish. Before the adult emerges the pupa darkens considerably. Length, 10 mm.

The adult.—The general appearance of the adult sawfly and the arrangement of the venation of the wings is shown by figure 15, *a*. A brief characterization of the genus was given by Norton in 1868,[a]

[a] Trans. Amer. Ent. Soc., Vol. II, p. 211.

with a description of the adult. As the latter is also brief, it is transcribed herewith. The original description appeared in 1862.[a]

♀. Color blue black; abdomen rather long, flattened, acute; antennæ slender, basal joint enlarged, third longer than fourth, apical joint as long as the preceding; clypeus angulate emarginate; labrum and base of mandibles pale rufous; legs rufous or honey yellow; base of coxæ and tarsi black; wings faintly clouded, stigma and costa black.

The length of the body, including the head, is three-tenths of an inch, and the expanded wings measure double that, three-fifths or about five-eighths of an inch in length. The type locality is Dorchester, Mass. It has also been reported from Canada by Provancher and from New York City by H. G. Dyar.

This species has been reared by Doctor Dyar from larvæ taken in New York City feeding on *Rumex* sp.[b] and knotweed (*Polygonum lapathifolium*),[c] and the larvæ have been described by him under the name *Strongylogaster abnormis* Prov. (a synonym).

Quite recently Dr. James Fletcher has mentioned the occurrence of this species in Canada. During 1902 the larvæ were reported in several localities in western Ontario, as also at Ottawa, injuring apples, the damage being of so serious a nature that the fruit was much disfigured and in many instances it was rendered unfit for market and was fed to pigs. The larvæ have also been observed feeding on Rumex and Polygonum in Canada.[d]

REMEDIES.

The remedy is to prevent the growth of dock and knotweed in beet fields and apple orchards, a matter not difficult of accomplishment if the weeds are hoed out in spring before the sawflies appear for oviposition.

THE PEPPER WEEVIL.

(*Anthonomus grandis* Boh.)

By C. M. Walker, *Temporary Field Agent.*

October 26, 1904, Mr. J. F. Nooe, Boerne, Tex., brought to the writer's attention specimens of sweet peppers which were infested with a species of Anthonomus. The close resemblance which this insect bears to the Mexican cotton-boll weevil has given rise to some confusion regarding the two species on the part of those interested in the growing of the affected crop.

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[a] Proc. Boston Soc. Nat. Hist., Vol. IX, p. 119.

[b] Trans. Amer. Ent. Soc., Vol. XXII, p. 311, 1895.

[c] Jour. N. Y. Ent. Soc., Vol. V, p. 199, 1897.

[d] Bul. 40, Div. Ent., U. S. Dept. Agric., p. 81 (1903); 34th Ann. Rept. Ent. Soc. Ont., 1903 [1904], p. 70; l. c. 1902 [1903]—brief mention.

DETERMINATION OF THE SPECIES.

Specimens of the pepper weevil were submitted to Mr. Schwarz, who reports as follows:

It is a species of Anthonomus hitherto not recorded from the United States, and is no doubt *A. æneotinctus*, described by Mr. G. C. Champion in the Biologia Centrali-Americana.[a] The few specimens found at San Antonio in November by Mr. Walker and myself on pepper plants agree perfectly with Champion's description. However, all the numerous specimens bred by Mr. Walker from pepper plants at Boerne, Tex., uniformly differ in having the legs throughout of a bright orange-yellow color, whereas in the more typical specimens the thighs are dark except at base. The difference, striking as it is, is most probably due to the immature condition of the Boerne specimens and the mature condition of the types. The pepper weevil, which is often confounded by farmers with the cotton-boll weevil, is much smaller and much shorter than the smallest specimens of the cotton-boll weevil. The legs are much shorter; the elytra are more convex and much less elongate than in the cotton-boll weevil; and, more especially, the front legs do not have a double tooth as in the boll weevil, but are furnished with a single, not very conspicuous tooth.

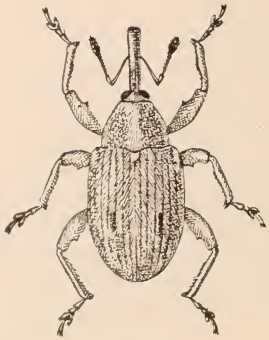

FIG. 16.—*Anthonomus æneotinctus:* weevil, much enlarged (after Hunter and Hinds).

DISTRIBUTION AND DESTRUCTIVENESS.

According to Mr. Louis Lamm, of Boerne, Tex., upon whose farm the insects occurred in large numbers, the weevil had been noticed there for two seasons, having been seen for the first time in October, 1903, and again during the summer of 1904, causing a loss of more than one-third of the crop each year. At San Antonio, Tex., a number of farms were so seriously infested during the previous season that the growing of sweet peppers as a market crop was discontinued by a number of market gardeners. Reports received at the San Antonio market show that a pepper weevil had been common for three or four years in that vicinity; there is not, however, conclusive proof that the insect referred to is identical with the species here considered, since a similar species has been reported on peppers in Texas. There exists an erroneous idea that peppers are often infested with the cotton-boll weevil, and it is possible that a confusion of these two species has given rise to some of the reports. According to present information, this species is not abundant in the State in localities other than those above mentioned.

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[a] Coleoptera, IV, pt. 4, February, 1903, p. 169, Pl. X, fig. 5.

INDICATIONS OF INJURY.

The first indications of injury by the pepper weevil may be seen in the dropping of the peppers and the general unhealthy aspect of the plant and of the fruit remaining thereon. The small peppers, becoming infested immediately after the blossoms fall, drop in large numbers, so that the ground at the base of the plants becomes strewn with the decaying fruit. This condition may be taken as a tolerably certain sign of infestation. Not only is the small fruit affected, but the full-grown peppers also fall to the ground; and if one of these be opened the interior will be found either wholly or partly blackened and decayed, the seeds having been eaten into and the pulp consumed, until finally decomposition completes the work of destruction. The author of this damage may be found, in most cases, within the pepper, either in the larval or pupal stage (Pl. I), or the adult itself may be found in the pod, from which it would ultimately have escaped by cutting away a hole just large enough to allow the passage of its body (Pl. I, fig. 2, *d*). In the small fruit the occurrence of eggs or young larvæ is indicated by the presence of scars made by the weevils either for oviposition or feeding. The large fruit often appears unsightly and misshapen from this injury. The absence of blooms is another indication of the presence of this pest. Although only a small proportion of the buds are usually infested, still, as those that have been punctured fail to bloom, the lack of blossoms is undoubtedly due, to a considerable extent, to the work of this insect.

LIFE HISTORY.

As is common with other species of Anthonomus, the eggs are placed in such a position as to be invisible to the naked eye and well protected from any conditions detrimental to their future development. Eggs are laid in the very small buds of the pepper plant, in the blooms, or in the young fruit just after the blossoms fall. The intermediate and also the mature stages of the fruit offer favorable conditions for the deposition of eggs. The weevils apparently prefer, however, to oviposit in the peppers immediately after the blooms fall, observations made in the field showing that fruit affected at this stage contained a relatively larger number of eggs than did the more mature peppers.

The female, with her long snout, bores a small hole through the pod (Pl. I, fig. 1, *b*, and fig. 2, *b*) and, if necessary for the reception of the egg, excavates a cavity in the adjacent seeds of the fruit. If the pepper has already attained sufficient growth so that the seeds do not come in contact with the outer wall of the pod, the egg may be left protruding, with about one-half of its length exposed on the inner

side of the pod. When oviposition occurs in small buds the egg is placed in a cavity excavated among the immature anthers.

The egg is pearly white when first deposited, but turns somewhat darker with advanced development. The form is quite regularly elliptical, tapering slightly toward the micropylar end, but varies somewhat according to the conditions of pressure encountered within the pepper. The average length is about 0.5 mm. and the width 0.3 mm. ($\frac{1}{50}$ by $\frac{1}{80}$ inch). There appear to be no characteristic markings on the outer membranes of the egg, which are soft and delicate and easily ruptured. Under normal conditions the egg hatches in from two to four days.

The newly hatched larva is about 0.5 mm. in length and has the appearance of a minute, white, legless grub. As it grows larger its color is modified by the contents of the alimentary canal.

The larva has the characteristic crescentic form common to most curculionids, with a large, light-colored head bearing darker colored mouth parts. Its growth is at first very rapid, especially during the first three days, and at the end of this time it is about three times its size when first hatched. At this stage the head is very large in proportion to the body, the latter being deeply wrinkled and covered with tubercles. At the age of 2 weeks, after undergoing at least one molt, the length averages nearly 5 mm., while the body has become much larger and stouter and the body wall more deeply wrinkled. Viewed laterally, the body tapers considerably from the middle toward the extremities. The head is of a light amber color, with conspicuous mouth parts. This stage appears to be that of the full-grown larva.

The amount of food available and the climatic changes naturally influence the growth of the larvæ, but under normal conditions the size of the same stage varies but little. This conclusion is borne out by the resulting slight variation in the size of the adults. The larvæ retain their crescent-shaped form throughout their growth, except that when about to change to the pupal condition they become somewhat flattened and the lateral swellings are more apparent.

After attaining full growth the larva transforms to a pupa within a cell (Pl. I, fig. 1, *c*) formed of dried excreta and decaying matter, and situated within the pepper pod, usually occupying the space which has been eaten away among the seeds. The cell is oval in form and varies somewhat in size, the average length being about 6 mm. Two or three cells are often present in a single pepper, and in some cases each one of the four interior compartments into which the pod is divided has nourished a larva. The location of the pupal cell appears to be a matter of no significance, as cells may be found at many different positions within the seed pod, the larvæ evidently

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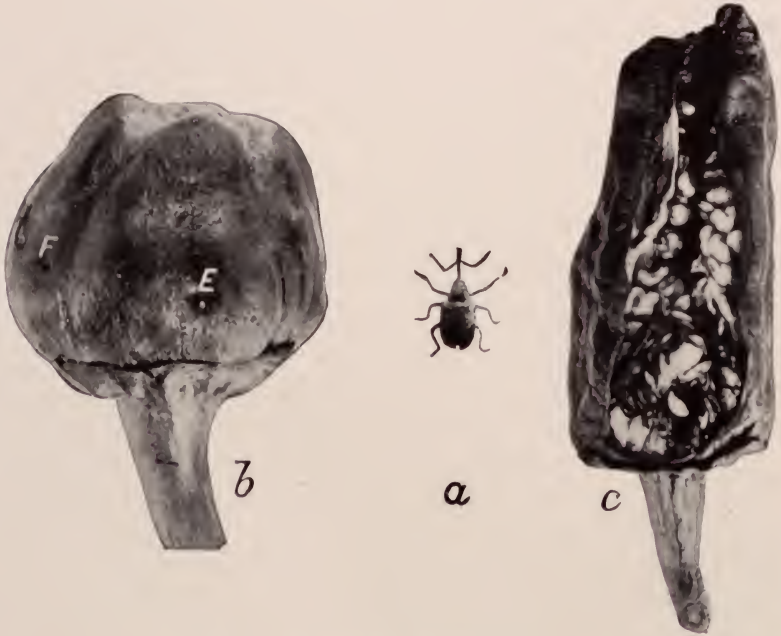

FIG. 1.—ANTHONOMUS ÆNEOTINCTUS.

a, Weevil, enlarged; *b*, short pod, showing an egg puncture (E) and a feeding puncture (F); *c*, opened pod, showing pupa in cell beneath.
[Photograph by W. E. Hinds.]

FIG. 2.—WORK OF PEPPER WEEVIL.

a, Bud of sweet pepper, showing many feeding punctures; *b*, small pod, showing one egg puncture above; *c*, section of pod, showing larva in opened cell beneath; *d*, small pod, showing exit hole of weevil.
[Photograph by W. E. Hinds.]

pupating near the portion upon which the last feeding was accomplished.

The pupa is short and robust, about 4 mm. in length, and nearly 3 mm. in breadth at its widest part. In color it is pale amber, with dark-brown eyes. The snout lies close to the ventral surface of the body. Above, the wing pads are conspicuous, and below them the legs protrude. The antennæ, arising from the snout, are folded below the head, and appear dorsally as knobbed appendages at the sides of the wing pads. The abdomen tapers to a point behind and, the outer segments being free, the tip can wriggle nervously, as it often does when the pupa is disturbed. The pupa is covered with tubercles, from each of which arises a long hair or spine. A short time before transformation to adult the color becomes much darker, the abdomen, however, retaining the original hue. The pupal stage occupies from six to ten days. Upon the full development of the adult the cell is broken open and the weevil emerges into the cavity of the pepper pod, remaining there until hardened, after which it cuts its way out through the pod wall (Pl. I, fig. 2, *d*). The color immediately upon emergence is light yellow, but in a few days this changes to a darker yellow-brown, becoming, finally, almost black, with the exception of the bases of the femora, which are orange.

FOOD AND FEEDING HABITS.

So far as is known to the writer, this insect has no other food plants than peppers; yet it is certain that it can exist upon at least three varieties of the plant, including the common "sweet pepper" and two varieties of the so-called "hot pepper." The weevil may also, perhaps, live upon a wild pepper which is common in wooded localities in southwestern Texas. The fruit of this plant, a small red berry, has an exceptionally pungent flavor and is used rather extensively in the manufacture of a variety of pepper sauce. There is a possibility that this "wild pepper" may prove to be the original food plant, but thus far the weevil has not been observed feeding upon it.

The young larva, when first hatched, feeds upon the soft, pulpy tissue forming the interior lining of the pod. This food it can obtain in abundance, since it is here, in the majority of cases, that the egg is deposited. Usually the larva does not attack the seeds until it has attained considerable growth, except in those cases in which the egg is placed in a cavity excavated for its reception in a seed. The seeds, extending out laterally in a cluster from the bases of attachment, offer secure lodgment for the larva, which eats away the outer edges and excavates the interior, thereby causing serious injury (Pl. I, fig. 2, *c*). The adult weevils appear to feed equally well in the fruit at different stages of growth, although the small, tender buds

seem to be the most seriously injured (Pl. I, fig. 2, *a*). By means of the sharp mandibles at the end of the snout the weevil will bore its way through the pod, eating from the center in a circle as far as the length of the proboscis will permit, sometimes increasing the distance by forcing the head and thorax into the opening made. A number of such punctures in a tender bud or young pepper will soon cause it to fall to the ground.

REMEDIAL SUGGESTIONS.

In view of the fact that the discovery of the work of this insect was made so late in the season that no experiments in the application of insecticides or other remedial measures could be performed, it is impossible at present to describe any sure method of destruction. A few suggestions, however, may prove of value to those who are directly interested. From the knowledge already gained concerning the feeding habits of the adult insect, which are very similar to those of the Mexican cotton-boll weevil, it is evident that the use of internal or stomach poisons, such as Paris green, would not give satisfactory results. Since the area devoted to the cultivation of peppers is not, as a rule, very extensive, there is one remedial measure which may be advised with some assurance of success, i. e., the gathering and destroying of the infested fallen fruit. As a general rule the peppers found upon the ground contain larvæ, pupæ, and even adult weevils in large numbers. If the fruit thus fallen be collected and destroyed by burning, or some other equally certain method, immense numbers of the weevils will be killed and the future crop protected to a certain extent from further infestation. If the fruit is allowed to remain on the ground, however, it will furnish a favorable opportunity for the development of the immature stages within the pods, and the adult weevils emerging therefrom will at once attack the peppers which may have escaped previous injury. The expense involved in this procedure would be slight, since the work may be done by unskilled persons with a reasonable chance of success. Judging from what has been learned of the life history of the insect, it is safe to say that, beginning as early in the season as the young buds or peppers begin to drop, a collection should be made as often as every fifth or seventh day, gathering not only all fallen fruit, but also all buds and pods still on the plants showing an unhealthy color, a deformity of shape, or any other sign of having been attacked. Whether the infestation be severe or slight, the interval between the collections, if this method of control be adopted, will be the same, since the interval depends upon the developmental period and not upon the abundance of the fallen fruit. If the collection of the fallen fruit be steadily followed up, the damage done by the weevil can, in all probability, be very largely prevented.

COLD STORAGE FOR COWPEAS.[a]

By J. W. T. Duvel, *Seed Laboratory, Bureau of Plant Industry.*

INTRODUCTION.

The value of cowpeas for the improvement of the soil as well as for forage has long been recognized. In recent years the area on which cowpeas are grown has been greatly extended. With the increased acreage there has been a more widespread distribution of the weevils destructive to cowpeas. Large quantities of seed are destroyed annually in this way, entailing a great loss to seedsmen.

Carefully conducted experiments, extending over a period of nearly two years, have shown that cowpeas can be kept free from weevils if stored at a temperature of 32° to 34° F. It is understood that this method is practiced to a limited extent by a few seedsmen, who find it

Fig. 17.—*a*, *Bruchus obtectus*; *b*, *B. chinensis*; *c*, *B. quadrimaculatus*—all much enlarged (after Chittenden).

far more satisfactory than the methods of fumigation which have been so generally used.

WEEVILS INFESTING COWPEAS.[b]

There are three kinds of weevils which do considerable damage to cowpeas during storage—the common bean weevil (*Bruchus obtectus* Say), the cowpea weevil (*Bruchus chinensis* Linn.), and the four-spotted bean weevil (*Bruchus quadrimaculatus* Fab.). The adult beetle of each of these species is shown in figure 17, *a*, *b*, and *c*. The

[a] What is here said concerning the storage of cowpeas applies equally well to garden peas and beans, and presumably to other seeds of a similar character which are attacked by weevils.

[b] The notes on the ravages and life history of these weevils are based on Dr. F. H. Chittenden's "Insects injurious to beans and peas," Yearbook United States Department of Agriculture for 1898, pp. 233–260. Figure 17 is taken from the same paper.

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first-named species is met with in cowpeas much less frequently than the last two.

The species breeding in the cowpeas which served as check samples to the series kept in cold storage were the cowpea weevil and the four-spotted bean weevil. The principal food of these two species is the cowpea, and they are found in most countries where cowpeas are grown. The first eggs are usually deposited in the field, but the greatest damage is generally done after the seed is stored. The beetles continue to develop in the dried and stored seed for several generations. Under favorable conditions, depending chiefly on the temperature, six or seven broods may develop within a year, according to Doctor Chittenden's observations. If not checked their ravages continue until the cowpeas are unfit for any practical purpose, not even serving for the sustenance of the weevils. Plate II, fig. 1, shows cowpeas which have been destroyed in this way.

CONDITIONS AND RESULTS OF EXPERIMENTS.

The experiments herein discussed were conducted with Clay cowpeas grown in Georgia in 1902. A germination test made of the bulk lot in February, 1903, showed a vitality of 83.5 per cent.

March 7, 1903, duplicate sets of twelve lots each, put up in cloth bags, were stored in "trade conditions," and in cold storage at Washington, D. C., Richmond, Va., Jacksonville, Fla., and New Orleans, La. At each of these places the "trade conditions" were represented by seed warehouses. The cold-storage samples were subjected to a temperature of 32° to 34° F. The remainder of the original bulk was kept in the seed laboratory at a temperature varying from 55° to 80° F. Samples from the entire series were tested from time to time for germination. The results of the tests are given in Table I.

TABLE I.—*Percentage of germination of cowpeas stored at various places under "trade conditions" and in cold storage on March 7, 1903, and returned from storage at various dates.*

Date of return of seeds from storage.[a]	Percentages of germination.								
	Original bulk lot kept in seed laboratory.[b]	Washington, D. C.		Richmond, Va.		Jacksonville, Fla.		New Orleans, La.	
		Trade conditions.	Cold storage.	Trade conditions.	Cold storage.	Trade conditions.	Cold storage.	Trade conditions.	Cold storage.
May 1, 1903	81	84.5	92	83.5	90.5	90.5	91.5	83	82.5
June 1, 1903	(c)	96	93.5	97.5	92.5	94.5	92	94	90
July 1, 1903	(c)	93	94.5	74.5	87	(c)	90.5	d 11	90
Aug. 1, 1903	(c)	d 68.5	92.5	(c)	87	(c)	83.5	d 27	88
Sept. 1, 1903	(c)	(c)	84	(c)	83.5	(c)	83.5	(c)	85
Nov. 1, 1903	(c)	(c)	96.5	(c)	94.5	(c)	97	(c)	93
June 1, 1904	(c)	(c)	87.5	(c)	70.5	(c)	85	(c)	75
Nov. 1, 1904	(c)	(c)	92	(c)	84.5	(c)	50	(c)	77

[a] The dates given are approximate only, varying slightly from actual dates of return of seeds from storage. Germination tests in all cases were made within a very few days after return of seeds from storage.

[b] The original bulk sample germinated 83.5 per cent in February, 1903.

[c] Destroyed by weevils.

[d] Many destroyed by weevils.

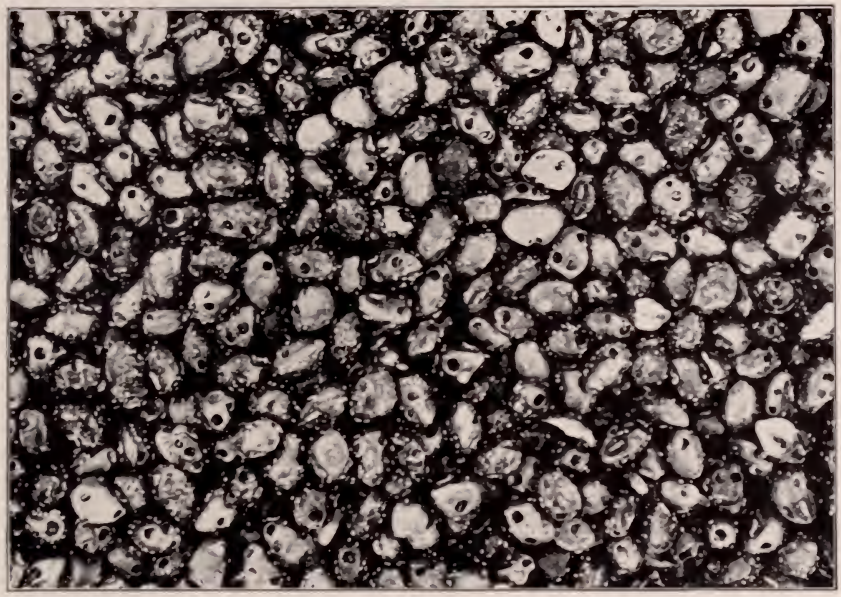

FIG. 1.—WEEVIL-EATEN COWPEAS FROM "TRADE CONDITIONS," WASHINGTON, D. C., SEPTEMBER 1, 1903—NATURAL SIZE (ORIGINAL).

FIG. 2.—COWPEAS FROM COLD STORAGE, WASHINGTON, D. C., SEPTEMBER 1, 1903—NATURAL SIZE (ORIGINAL).

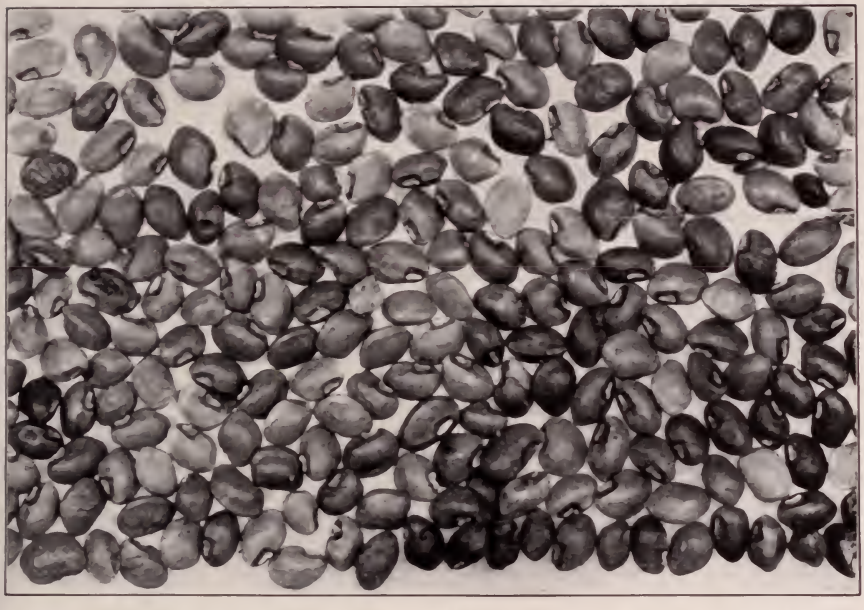

FIG. 1.—COWPEAS IN COLD STORAGE FROM MARCH 7, 1903, TO MAY 1, 1903, AFTER WHICH TIME THEY WERE STORED IN THE SEED LABORATORY (ORIGINAL).

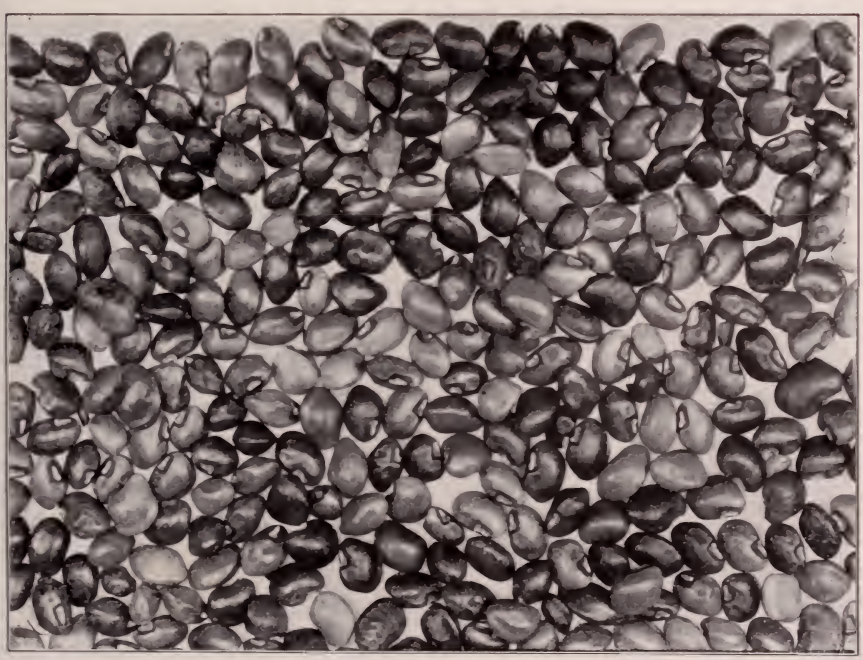

FIG. 2.—COWPEAS IN COLD STORAGE FROM MARCH 7, 1903, TO NOVEMBER 1, 1904 (ORIGINAL).

The table shows that the period of storage extends over two summers, from March 7, 1903, to November, 1904. Throughout this entire period the cowpeas kept in cold storage were not injured by weevils and showed practically no deterioration in vitality. On the other hand, the cowpeas stored in "trade conditions" were all destroyed by weevils during the first summer. The bulk lot kept in the seed laboratory, Bureau of Plant Industry, where the temperature was very favorable for the development of the weevils, was the first to be destroyed. In May, 1903, this seed germinated 81 per cent, but one month later the weevils had destroyed every seed. At this time the beetles were present in such numbers as to cause a rise in temperature within the bag of seed of 11.5° C. (20.7° F.). Samples from Jacksonville germinated 90.5 per cent in May and 94.5 per cent in June, 1903, but by the 1st of July the seed had been destroyed by weevils. The seed stored at Richmond was not all destroyed until the August test. The Washington and New Orleans series showed complete failure in the September test, but in each of these cases many seeds were destroyed at the time earlier tests were made.

The foregoing results with the cowpeas kept in "trade conditions" illustrate exactly what has been experienced by every seedsman who has attempted to carry cowpeas over the summer in his warehouse. However, where the seeds are handled in large bulk they will be destroyed much earlier in the season, as a result of the heat generated by the weevils during the transformation stage. As a result of this heat the second brood will develop much more quickly than was the case with small lots as used for these experiments. The actual commercial conditions with seed stored in quantity would be much the same as shown in the control sample stored in the seed laboratory—that is, the seed would be destroyed earlier in the season. Plate II shows cowpeas which were kept in "trade conditions" (fig. 1) and in cold storage (fig. 2) at Washington, D. C. The photographs were taken September 1, 1903, approximately six months after the seeds were stored. Figure 1 shows the weevil-eaten cowpeas, which failed to show a single germinable seed; figure 2, the cowpeas after six months in cold storage. These cowpeas had not deteriorated in vitality and germinated 84 per cent.

EFFECT OF COLD STORAGE ON THE VITALITY OF THE SEED AND THE FUTURE DEVELOPMENT OF THE WEEVILS.

The samples of seed were tested for germination as they were taken from cold storage. The remainder of each sample was then stored in tin boxes. The temperature of the laboratory where the seeds were stored was slightly higher than that of the ordinary living room

It was supposed that the weevils would develop in the cowpeas after they were taken from cold storage and subjected to a higher temperature, but in no case did the weevils ever develop, not even in the samples which were taken from cold storage May 1, 1903, less than two months from the time they were first put into the cold-storage room.

The samples from cold storage were tested again for germination March 11, 1905, two years after the beginning of the experiment. The results of the germination tests are shown in Table II, together with the approximate time the samples were in cold storage and the time they were subsequently stored in the seed laboratory.

TABLE II.—*Percentages of germination of cowpeas stored at various places at a temperature varying from 32° to 34° F. for from two to twenty months, and then in seed laboratory at a temperature varying from 60° to 80° F. for from four to twenty-two months.*[a]

Duration of storage.[b]		Percentages of germination.			
In cold storage, 32°-34° F.	In laboratory, 60°-80° F.	Washington, D. C.	Richmond, Va.	Jacksonville, Fla.	New Orleans, La.
Months.	*Months.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
2	22	79.5	80	81.5	77.5
3	21	81	84.5	86.5	84.5
4	20	73.5	83	77.5	76
5	19	80.5	77	81.5	71
6	18	81	82.5	83.5	86
7	17	75	78	92	79
15	9	83.5	85	79	79
20	4	70.5	79.5	64.5	79
Average		78.06	81.21	80.75	79

[a] Seeds placed in cold storage March 7, 1903; tested March 11, 1905.
[b] Durations of storage here given are approximate only, varying slightly from actual number of days of storage.

Table II shows that the vitality of the samples remained practically uniform, regardless of the length of time they were kept in cold storage. This fact should clear up any doubts, which so many seedsmen have entertained, that seeds kept in cold storage would deteriorate very rapidly if afterwards subjected to atmospheric changes of temperature. The results, it is true, are somewhat lower than those given in Table I, and the average percentages of germination are likewise lower than the germination of the original control sample. But this must be considered as a natural deterioration, inasmuch as the peas at the time of this test were two and one-half years old. The test showing the lowest percentage of germination, No. 8, was from Jacksonville. When this sample was received it bore indications of being damaged by moisture, and the test made at that time (November 1, 1904) showed a vitality of only 50 per cent.

There was, however, a marked difference in the color of the cowpeas. The earlier samples taken from cold storage had darkened

in color, while the peas fresh from the cold storage room were not discolored, save, perhaps, an occasional seed. These differences in color are shown in Plate III (figs. 1 and 2).

COST OF COLD STORAGE.

While a few seedsmen have adopted the method of keeping cowpeas in cold storage, the majority contend that it is too expensive. Those who practice the cold-storage treatment, however, find it entirely practicable and economical. Data obtained from a number of the largest and best equipped cold-storage houses in the United States show that the cost of storing a bushel of seed of this kind varies from 3.6 to 7.5 cents a month, depending chiefly upon the quantity stored. The former price is for seed stored in carload lots and the latter for quantities of 100 bushels or less. The cost of cold storage for the season, from four to seven months, ranges from 15 to 25 cents per bushel, depending upon the length of time and the quantity of seed stored. A number of the cold-storage men are already familiar with the handling of stock of this kind, and from those the lowest prices were submitted. But to pay the highest price, 25 cents per bushel for the season, is analogous to paying that price for a new stock of seed.

HOW SEED SHOULD BE STORED.

Cowpeas, when kept in cold storage, should be handled in bags, just as in the warehouse. The objection frequently raised by those who are unfamiliar with the cold-storage method is that of excessive moisture, the contention being that cold storage would necessitate special containers. This objection, however, is not a valid one, for, at a temperature of 32° to 34° F. the air can retain but a comparatively small quantity of water vapor. Furthermore, at low temperatures moisture is much less deleterious to vitality than at temperatures such as are found during the summer months in warm, moist climates, where seeds of all kinds soon lose their vitality. It is, however, desirable to keep the seed as dry as possible, and separate cold-storage rooms should be provided for stock of this character.

If the bags of seed are taken from cold storage and placed in a warm, moist room, there may be in exceptional cases a sufficient condensation of moisture to cause "sweating." But if the cold storage room has been dry and a good circulation of air is maintained between the bags for a short time after they are taken from cold storage, the temperature of the seed will soon be the same as that of the surrounding air and the danger of "sweating" will be overcome.

SUMMARY.

Cowpeas can be kept free from weevils if maintained at a temperature of from 32° to 34° F.

The vitality of the seed is in no way injured by the cold-storage treatment.

Cowpeas can be carried through the summer in cold storage at a cost ranging from 15 to 25 cents per bushel for the season.

It is not necessary that the seed be planted soon after it is taken from cold storage and subjected to atmospheric temperatures: for this is not followed by a more rapid deterioration in vitality.

The storage room should be kept as dry as possible, and the seeds handled in bags as in the warehouse.

THE LARGER CANNA LEAF-ROLLER.

(*Calpodes ethlius* Cram.)

By F. H. Chittenden.

During the past two years the leaf-rolling caterpillar of *Calpodes ethlius* Cram. has attracted considerable attention from its ravages in fields of canna in portions of South Carolina and Alabama.

In September, 1903, Mr. H. M. Simons wrote of its attacking the foliage of the canna plant in the vicinity of Myers, S. C., sending specimens in all stages except the egg, the first adult issuing September 21.

In September, 1904, a similar lot of specimens were received from Mr. L. H. Read, Fruitdale, Ala., who wrote of the difficulty of capturing the butterflies, although they were quite plentiful among the canna plants. Thousands of the caterpillars were in the fields, and hand-picking was out of the question. All bronze varieties of canna were injured, including eight or ten varieties. Among those most attacked were Mississippi, Mont Blanc, Explorateur, Crampbell, and Italia. A few green varieties were somewhat affected, but as a rule were scarcely touched, obviously owing to their thicker and tougher leaves. The caterpillar was observed at work only at night.

In 1904, also, the species was observed somewhat abundantly at Baton Rouge, La., by Mr. A. L. Quaintance, and sparingly at New Orleans, La., by Mr. E. S. G. Titus. Although only two instances of severe injury are cited, these are doubtless merely representative of many which were not reported.

This species and its injuries have been known for many years, yet no comprehensive article on it has, to our knowledge, appeared in any work on economic entomology, although the insect in its various stages was described in detail by Dr. S. H. Scudder in his Butterflies

of the Eastern United States and Canada.[a] The entire appearance of the insect from the larval stage to the adult is indicative of its tropical origin, and it is still somewhat restricted to the South. There is a possibility, however, that it might gradually extend its present distribution if it could obtain a footing in greenhouses where cannas are grown.

DESCRIPTIVE.

The butterfly.—The parent of this singular leaf-roller is a butterfly belonging to the subfamily Pamphilinæ of the family Hesperiidæ, or skippers. It is one of the larger skippers, with a wing expanse of between 1 and 1¼ inches. The head is very broad, with large eyes, and the body is thick and heavy. The upper surface of the head,

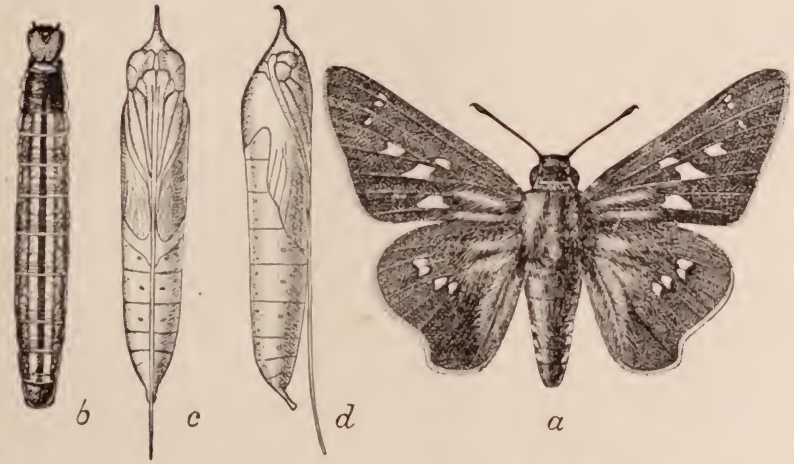

FIG. 18.—*Calpodes ethlius: a*, butterfly; *b*, larva; *c*, pupa, front view; *d*, pupa, side view—all enlarged (original).

thorax, and a portion of the abdomen is thickly covered with long olive hairs. The wings are dark brown, with white semitransparent spots, arranged as in figure 18, which also shows the location of the masses of yellowish hairs, the contour of the wings, and structure of the antennæ. The lower surface of the wings is much paler brown, or fulvous, and more nearly uniform in color. The head and body are still paler yellowish. The adult is sometimes called the Brazilian skipper.

The egg is illustrated by Scudder. It is subhemispherical in outline, as viewed from the side, and has a convex base, while the surface is very irregularly reticulated, in most cases pentagonally. The broadest diameter is 1.25 mm.; height about 0.7 mm. Eggs have not been

[a] Vol. II, pp. 1750–1757, 1889.

seen by the writer. and the color does not appear to have been designated.

The larva or caterpillar is quite remarkable because of its semi-transparency. Its surface is without hair and the general color is moderately pale green, with dark-orange subtriangular head, which is marked by a frontal subtriangular space. The thoracic segments are greenish testaceous and more or less tinged with orange, at least in preserved specimens. The remainder of the body is nearly transparent, presenting a view of the vascular and nervous system beneath the skin, as illustrated in figure 18, *b*. The length of the larva, when full grown, is about $1\frac{3}{4}$ inches.

The pupa is nearly as striking as is the larva. It is of similar pale greenish color and of the appearance shown in figure 18, *c*, *d*. The head is prolonged into a curved process, and the tongue extends in a nearly straight line considerably beyond the prolonged anal tubercle. Without the projections it is nearly as long as the larva.

DISTRIBUTION.

Scudder states that the principal range of this species is from Central America to the northern parts of the South American Continent, although it inhabits, also, the extreme Southern States of our Union. So far as can be learned it is still known only from the Gulf States, South Carolina, and Porto Rico in our domains. It also inhabits Cuba and Jamaica, however, and in South America occurs as far south as Argentina, where it was years ago reported to be common by Burmeister.

ACCOUNTS OF INJURY.

In the records of the Bureau of Entomology we have accounts of injuries and of other observations on this species, as follows: June 7, 1880, we received from Dr. J. H. Mellichamp, Bluffton, S. C., a report that the larva had utterly destroyed some luxuriant plants of *Canna flaccida* in his garden. August 9, 1887, we received from Mr. A. L. Townsend, Bay Ridge, Long Island, report that the species did much damage to French cannas and *Caladium esculentum*. In our rearing cages the butterflies hatched June 12 and August 26.

The caterpillars appear to affect only plants of the genus Canna, when they are obtainable, and sometimes they are so abundant as to do much damage, at times utterly destroying luxuriant plants. Dr. H. G. Dyar mentions a case where the larvæ were eating the leaves of canna planted in the grounds of a hotel at Miami, Fla., considerably injuring the appearance of the plants.

Eggs are laid singly and separately, sometimes in groups of from 5 to 7, on the under surface of leaves. According to Miss Helen King[a] they hatch in Texas in six days, while in Florida, according to Wittfeld, they may hatch in four days.

On hatching, the caterpillar, as is common with many species, devours a portion of its eggshell, whereupon, after feeding lightly on a leaf, it folds the latter over and confines it in place with a few stitches of silk, enlarging its retreat as it develops. From the tubular case thus formed it feeds along the edges and retreats within when disturbed. It is careful to eject all excreta and exuviæ, but in spite of its cleanliness the caterpillar is frequently attacked by disease.

A good account is given by Miss King in the article above noted, which is largely republished in Scudder's work. Doctor Dyar has ascertained that there are customarily five stages of this larva, and describes them fully in Entomological News.[b] The larva, when full grown, develops to a pupa in its resting place, "held by a transverse loop and a band of silk for the cremaster." "The cremasterial band is attached at one end to the leaf; at the other to the transverse thread." This accurately describes the pupal case as observed in specimens received at this office. Under other conditions this case might be different, as described by Mr. Charles R. Dodge.[c]

According to data accumulated by Scudder, the butterfly is on the wing in southern Florida in May, and from eggs laid in the middle of the month the butterflies reappear in the first half of June. In South Carolina the season is a little later, and there mature caterpillars have been observed before the middle of June and fresh butterflies from the 12th of the month to the end. Scudder concludes that there are two generations before midsummer. Judging by recent experience there are likely to be two more generations before cold weather, but we do not know how the winter is passed. The moths from one of these generations appear in the latter part of September.

Of the butterfly Angus has stated that he was attracted to an individual, which he captured near New York City, "by the peculiarity of its movements on the wing; they were very undulating, like those of gnats, as they rose and fell almost perpendicularly and in a very easy manner." Wittfeld adds that one of the favorite times for flight of the butterfly in fair weather is after sundown. Miss Helen King describes its motion as "very rapid."

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[a] Psyche, Vol. III, pp. 322–324, 1882.

[b] Pages 163–165, 1898.

[c] Rural Carolinian, Vol. III, p. 593.

The large holes made by this leaf-roller in the leaves of canna and the rolled-up leaves, together with the excrement, which will be found below the affected leaves, will serve to indicate its presence, and its large size permits the control of the insect by hand-picking. Any of the arsenicals will kill it, but their use is not always desirable because of the presence of children in the vicinity and the fear of their being poisoned. An ordinary spraying with an arsenical, preferably arsenate of lead combined with Bordeaux mixture, could, however, be made without any real danger of poisoning. After an arsenical has been used, Bordeaux mixture should be tried alone as a repellent.

THE POND-LILY LEAF-BEETLE.

(*Galerucella nymphææ* Linn.)

By F. H. Chittenden.

During the first week of August, 1904, this leaf-beetle became so abundant in the District of Columbia that it deserted its natural food plants—aquatic species of the genera Nymphæa, Sagittaria, Brasenia, and Nuphar—and attacked near-by plants of other botanical families not at all related to those which form its normal food. Mr. George B. Sudworth, of the Bureau of Forestry, reported the species on basket willow, remarking that it appeared capable of doing considerable damage to this plant. Mr. Sedgwick N. Lander reported injury to beans. In both cases numerous living specimens of the beetles were furnished. August 4 Mr. J. L. Reeves visited Mr. Lander's place, and with little effort obtained a thousand or more of the beetles by sweeping the infested plants. In confinement the beetles fed for several weeks on the leaves of both willow and bean, gnawing minute holes from the epidermis of the upper surface, thereby producing the effect of fine network.

This species is evidently of foreign origin and is now common to both continents, and its semiaquatic habits are familiar to most collectors. The writer has in mind another report, made August 3, 1899, by Mr. R. Balluff, of injury to a native pond lily (*Nymphæa* sp.) growing on the grounds of the Executive Mansion at Washington. As this leaf-beetle does not appear to have been mentioned hitherto in any publications of this Department, a short account may be interesting.

The species has frequently received mention under the name *Galeruca sagittariæ* Gyll. It is related to the common cucumber beetles, belonging to the same tribe, the Galerucinæ, of the Chrysomelidæ or leaf-beetles. The beetle (fig. 19) measures about one-fourth of

an inch in length, and may be distinguished from other species in our fauna by a number of characters, among which are its perfectly smooth thorax, pale elytral margin, acute sutural angles, and completely separated middle coxæ, this separation being due to a prolongation of the mesosternum meeting the metasternum. The thorax is dull yellow, with three piceous spots, and the elytra are darker brown, somewhat coarsely and densely punctate.

This insect occurs abundantly throughout northern Europe and Siberia, and in the northern portion of our own continent from the Hudson Bay region southward to the District of Columbia and Virginia. It is recorded also from Texas, California, and Oregon, but does not seem to have been recognized in neighboring States. It seems probable that it was introduced many years ago from the Eastern Hemisphere.

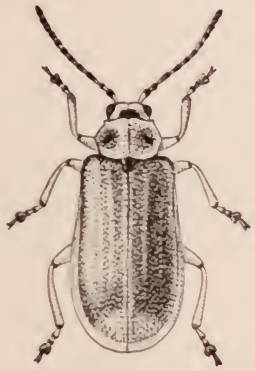

Fig. 19.—*Galerucella nymphææ*, about six times enlarged (original)

An account of the earlier stages of this species, with notes on its habits and illustration of larva, pupa, and adult, were given as early as 1775 by Baron De Geer.[a] Later writers have also described the earlier stages, the list including Bargagli, Gadeau, Weise, and Quilter.[b] The description by the last-mentioned author, in the writer's opinion, can only be doubtfully referred to this species. He states that the larvæ occur on *Polygonum amphibium* in England, concludes that the parent deposits eggs at the root of its food plant, and that the larvæ are consequently aquatic, coming up out of the water to pupate on leaves and stalks of aquatic plants. He also describes the beetles as turning black in two or three hours after transformation, which is not true of this species.

Of the earlier stages in America, the late F. G. Schaupp described the larva in 1883, briefly characterizing the eggs and pupa.[c] More detailed descriptions have been furnished by A. D. MacGillivray.[d] The eggs are ovate, shining yellow, and are laid in small patches of from 6 to 20 on the upper surface of the leaf. Larvæ, pupæ, and beetles in all stages of growth were observed near New York City in July. The larva is bluish-black above, and yellow on the

[a] Memoires pour servir a L'histoire des Insectes, Vol. V, pp. 326–329, Pl. 10, figs. 1–6.

[b] The Entomologist, Vol. XX, pp. 178–181, 1887.

[c] Bul. Brooklyn Ent. Soc., Vol. VI, p. 54.

[d] Bul. 68, N. Y. State Mus., 1903, pp. 325, 326.

under surface, of elongate form, when full grown measuring three-eighths of an inch in length; widest at the middle, and tapering toward either extremity. Many larvæ are frequently found together on a single leaf, where they eat the upper surface, doubtless because the lower surface of the leaves of the natural food plants rest on the water. As a result of these attacks the leaves become brown and unsightly. The white lily is less affected than yellow lilies.

As to remedies, the arsenicals are quite effective, and Paris green is reported by Mr. Sudworth as checking the ravages of the beetles on willow. When spraying bean plants, arsenate of lead is preferable, owing to the danger of scalding the more tender leaves if Paris green is used. When this species occurs in troublesome numbers on aquatic plants it might readily be destroyed in all stages, and especially as larva, if the ponds, fountains, or other places in which the lilies are growing could be flooded so as to bring the insects to the surface. A few drops of kerosene spilled on the water would then destroy the floating insects.

GRASSHOPPER CONDITIONS IN NEBRASKA, NORTHEASTERN COLORADO, WYOMING, MONTANA, AND WESTERN KANSAS DURING THE SUMMER OF 1904.

By Lawrence Bruner, *Temporary Field Agent.*

In compliance with instructions received last July, the writer spent the greater portion of the month of August in endeavoring to ascertain the existing status of the grasshopper, or locust plague, throughout the region lying to the east of the main divide of the Rocky Mountains and west of the Missouri River. In order to accomplish this work in a satisfactory manner several journeys were undertaken over the various lines of railroads located in the region under investigation. The officers of all of these roads cooperated in the work by kindly providing all transportation necessary for visiting the various localities known to have been infested by these insects during recent years.

In order to ascertain more clearly the conditions in Colorado, the entomologist of the State Agricultural College, Prof. C. P. Gillette was consulted. Visits were also made to the Agricultural College of Montana and to the State University of Wyoming, where important data bearing on the subject under investigation were obtained. Some additional records of grasshopper abundance were gathered from the daily press reports, while data bearing on the presence of locusts in other localities not visited were gleaned from various persons.

By carefully arranging and studying all the information accumulated it would seem that the general status of the locust pest, over

the region embraced in these studies, is greatly improving. Practically everywhere these insects are rapidly decreasing and getting down to their normal numbers or even below the normal. Of course, the causes for this decrease are various, being somewhat different in each locality affected. These causes were given and discussed to some extent in my report at the close of the season's work during the summer of 1901.[a]

August 2, 1904, the writer left Lincoln for the purpose of visiting southwestern Nebraska and eastern Colorado, taking a daylight train. A careful outlook was kept from the car windows for signs of locust injuries or the presence of these insects in more than ordinary numbers. Not until after leaving Oxford, however, were such indications observed. But from a few miles west of that place all the way to McCook it was clearly indicated, both by the presence of the insects on weeds along the right of way and by more or less damage to the outer rows of corn growing near alfalfa and small grain, as well as by deserted and weedy fields. Each of these conditions was occasionally quite apparent, even from the moving train, and increased westward. The species of locusts most concerned in these ravages were two: *Melanoplus differentialis* Thos. and *M. bivittatus* Say. These two forms habitually frequent low ground and other areas overgrown with rank vegetation.

The morning of August 3 was spent in the vicinity of McCook. Here it was found that several additional species of locusts, like *M. femur-rubrum* DeG. and *M. atlanis* Riley, were quite numerous, both in alfalfa fields and on the prairies. The deserted fields which had grown up to rank weeds were the homes of still other species, of which *Æoloplus regalis* Scudder and *Melanoplus lakinus* Scudder were the chief forms. These latter were quite partial to Russian thistle and lambs-quarters as food plants. *Hesperotettix speciosus* Scudder, which is a feeder on Helianthus, was very common, while several of the grass-infesting species were present in numbers above the normal as observed during ordinary years. These latter, however, were concentrated at places where the grasses still showed green, and possibly, on account of this bunching, their abnormal abundance may have been only seeming. It might be well to state that this particular region was suffering greatly from drought, a fact which undoubtedly had much to do in causing the more than ordinary locust injury.

Leaving McCook, the writer had an opportunity of seeing the conditions along the Republican Valley almost to the southwestern corner of the State. Just beyond the junction of the Frenchman and the Republican rivers it was noted that the drought conditions were less severe, and vegetation improved as we progressed west-

[a] See Bul. 38, n. s., Divison of Entomology, U. S. Dept. Agr., pp. 39–49, 1904.

ward. Some species of locusts and a few signs of their injuries were still occasionally apparent, even as far as Haigler, Nebr. Here a halt of over a day was made. A comparison of the conditions as found here this year with those of a year ago showed a great improvement. Possibly only half as many of the insects were present this year as last, and these were pretty well bunched in certain weed patches and alfalfa fields located in the valley near the river, whereas last year they were quite generally distributed. Beyond Haigler but few locusts were found in hurtful numbers, indicating that this locality is almost on the western boundary line of the plague. From Wray, Colo., all the way to Denver, their numbers seemed to have dwindled to normal, or even below. At least, such appeared to be the condition along the line of the Burlington Railway. In fact, as nearly as I was able to ascertain, this condition prevails throughout most of Colorado east of the Rocky Mountains, save perhaps in two or three isolated localities in the valleys of the Arkansas and South Platte rivers near the State line. The diminution in their numbers appears to be due chiefly to fungous diseases and natural enemies, both of which seem to have been abnormally effective during the past two or three years.

All of the region lying along the eastern base of the range between Denver and Fort Collins was at this time remarkably free from these insects. None whatever were seen while riding between the two cities named, although a careful watch was kept throughout the journey, and an inquiry at the agricultural college located at the latter place elicited the information that hoppers were scarce in Colorado, while few or no reports had been received the present season concerning their presence or ravages.

Going east from Fort Collins, a few of the insects, it was learned, were to be found in and about alfalfa fields in the vicinity of Greeley. Northward from Greeley to Cheyenne, Wyo., no species of grasshoppers were seen in abnormal numbers. Nor were they found to be present along the Union Pacific Railroad between Cheyenne and Laramie in sufficient numbers to be noticeable. At Laramie few individuals of any species were to be seen, although several trips were made for the special purpose of obtaining specimens. Professor Buffum, director of the experiment station, who does the entomological work in that State, also informed me that, so far as he knew, similar conditions prevailed over much of the State of Wyoming.

Leaving Laramie and proceeding eastward over the Union Pacific Railway, no grasshopper signs were visible at any point between Cheyenne and North Platte. It was ascertained by inquiry that although considerable injury had been done by locusts for several years, and even as recently as the year 1903, they appeared to have dwindled to such an extent that this year they were not

present in numbers above normal. Then, too, the person in charge of the branch of the Nebraska Experiment Station located near that place reported like conditions. As the train approached Gothenburg, and from that point as far eastward as Kearney, some signs of local abundance and slight injury by two or three species were apparent. Now and then corn fields and weed patches adjoining alfalfa fields showed their ravages. In two instances magnificent examples of the usefulness of birds as locust destroyers were noted. In both cases the birds in question were gulls, possibly Franklin's or the laughing gull. These birds were present in flocks of fifty or more and were congregated on alfalfa fields which showed decided marks of locust injuries; and it was plainly evident from their actions that the birds were feeding, since some of them were on the ground and others in the air. One of these flocks was near Gothenburg and the other not far from Kearney. Some days afterwards a gentleman from the latter place told me of a similar sight that he himself had witnessed. It is probable that these birds were nesting on the artificial lakes made by damming up the mouths of ravines in connection with irrigation and power ditches in the vicinity, and were occupied in foraging.

There appeared to be no locust injuries along the Platte Valley much lower down stream than Kearney, although it was followed as far as Grand Island, where a change was made to the Burlington road so as to reach Lincoln via Aurora and York.

Leaving home again on August 10, and going by way of the Chicago and Northwestern Railroad up the Elkhorn, the writer did not observe hoppers in hurtful numbers east of Chadron and Crawford on the Little White River. Even here a comparison with conditions as observed by the writer a year ago showed the pest to be largely on the decline. Scarcely any traces of injury were visible even about the edges of cornfields adjoining alfalfa and weed patches—the localities most commonly frequented by the species of locusts most abundant here. The journey was continued westward as far as Casper, Wyo., where in 1901 considerable grasshopper injury occurred, as observed by the writer during a visit made at the time. A trip into the country a few miles from Casper showed but few locusts. Even the usually abundant prairie or plains forms were below the normal in numbers, and in some places decidedly scarce. Inquiries among ranchmen elicited the information that the pest was gradually becoming scarcer throughout the alfalfa growing district to the southeast of the town, where some marked damage had been done by the insects as late as a year ago. Returning to Crawford, Nebr., a stop was made in order to observe conditions away from the town and railroad. The result was as stated for Casper. From here the writer returned to Lincoln over the Billings and Black Hills

branch of the Burlington, but no locust depredations were encountered or reported en route.

Learning that several good rains had fallen since his former visit to the upper Republican Valley, the writer, on August 17 and 18, made a second trip to southwestern Nebraska. At this time vegetation was greatly improved in appearance and the hoppers were somewhat scattered as compared with two weeks before.

The last trip of the month was made to northern Wyoming and portions of Montana, where last year considerable locust injury occurred both in cultivated districts and on the ranges. While locusts were this year normally abundant in the valley of the Yellowstone River from a short distance above Billings nearly to Livingston, their work was only occasionally perceptible from the car windows. In this particular district the reports of greatest injury came from Red Lodge and vicinity, not far from the Wyoming line. Here the species concerned were chiefly *Aulocara elliotti* Thom., *A. femoratum* Scudd., and several other plains-inhabiting species like *Melanoplus infantilis* Scudd., *M. occidentalis* Thom., *M. packardii* Scudd., *Cordillacris occipitalis* Thom., and *Mestobregma kiowa* Thom. Besides being infested with abnormal numbers of these insects, the region in question, as well as much of the adjoining territory, was badly affected by drought. These two causes combined to render the grazing exceedingly poor. Considering the dwindling in numbers from last year to the present time it seems that the pest is quite certainly on the decrease, even in the district of greatest abundance.

August 23 to 25, inclusive, a drive was taken through the Gallatin valleys in company with President Reed and Professor Cooley of the Montana Agricultural College. No locust injuries of importance were found, but in certain areas several species were present in numbers most certainly above normal for the district. There were two species of Melanoplus, a form of *atlanis* and an undetermined species, and *Camnula pellucida* Scudd. Last year a much more extended district was overrun. *Encoptolophus sordidus* Burm., which was abundant in 1903, was rare this year.

A visit to Helena and the immediately adjoining regions showed the various local species of locusts to be much below the normal in abundance as compared with former years.

While no work was done in western Kansas and southeastern Colorado, it was learned through others that some locust damage occurred in the vicinity of Garden City, Kans., among the alfalfa fields, but efforts at remedying the evil were being made. Machines were in use, poisoning with the bran-arsenic mixture was regularly carried on, and large flocks of turkeys were being employed to rid the fields of the pest.

NOTES ON THE BEHAVIOR OF THE COLORADO POTATO BEETLE IN GREAT BRITAIN.

(*Leptinotarsa* [*Doryphora*] *decemlineata* Say).

By Fred. V. Theobald.

Wye Court, *Wye, England.*

The advent of the Colorado potato beetle into Great Britain in 1901 gave rise to grave apprehensions, which, judging from its behavior during its stay on our shores, were certainly not unfounded. For once the country was prepared to deal drastically with this unwelcome intruder, for a bill had been passed by both Houses of Parliament in 1877 by means of which the existing board of agriculture has power to take over land infested with the Colorado potato beetle so as to insure its eradication. The necessity of this measure was amply shown during 1901 and 1902 when the "spearman"[a] was present in this country.

The few notes I made on the general behavior of this beetle during its stay with us may not be unwelcome to those in whose land it flourishes, and of interest to others into whose country it may any day be imported. I believe the British invasion is only the third that has occurred in Europe, the two previous outbreaks having occurred in Germany some years ago.

The beetle was reported to the officials at the board of agriculture in August, 1901, as being present in some allotments in Tilbury Dockyard. On the 22d of that month I visited the dockyard and found the beetles very active and full of generative vitality. They were not numerous, some two dozen or more only being observed, but many more had evidently been at work and some had been collected and killed. At this time they were depositing eggs, and I found larvæ in all stages of development. At a glance one could see that the beetles had been at work some time; probably the colony had been there some months before it was detected. The potatoes were noticeably defoliated, but mainly, it seemed, by the larvæ and not by the adults. The beetles did not seem to take wing, but were most active, crawling about in the bright sunshine. I never saw one take wing in the open, but those I brought away for further observation became most active in the breeding cages, frequently using their rosy wings and dashing up against the glass of the cages. Later I noticed them in my garden taking short flights under their muslin tents.

The land where this colony had taken up its abode was treated in

[a] A name sometimes given to the Colorado potato beetle, based on the old generic term Doryphora.

a very drastic manner by the board of agriculture's officials, but as we shall see, without clearing the land completely of this serious pest. The potato haulm [a] was cleared and fired with paraffin and the ground heavily coated with gas lime and later plowed up. The land was also soaked with paraffin, and gas lime was put on at the rate of 60 tons per acre. I may here mention that one of the inspectors of the board of agriculture and myself found that the beetles could live in a tin of gas lime unharmed; one would not, therefore, expect this unknown quantity to be effective against the adults, although its caustic properties should destroy larvæ and pupæ. It does not do so, however, for reasons which I shall point out.

The land and the neighboring plats of potatoes and the district for some 3 miles around were examined later and no further specimens were found. I went to Tilbury again on September 17, 1901, and could find no trace of beetles, larvæ, or eggs around the invaded area. I brought some twenty beetles and larvæ away with me on the first visit and kept these in confinement in breeding cages under safe guardianship in my garden. The larvæ all became mature by September 23. In very few cases did I notice the beetles feeding, but the larvæ, especially in their closing stages, were most ravenous. Besides potato, I fed some on tomato and found they did not thrive so well, others on deadly nightshade (*Atropa belladonna*) and on sow thistle (*Sonchus oleraceus*), on both of which they flourished admirably. Some eggs were found on the sow thistle at Tilbury; hence I tried it as a food plant. Soon after bringing the specimens home I found that the adults readily buried themselves in the earth when the weather was dull and cool. Several adults which I took in August lived until the following spring, a few died, and others deposited eggs. The eggs found at Tilbury varied greatly in color according to age, some being yellow, others deep orange. They varied in number in the last batch from 9 up to 40. The beetles, it seemed, did not mind whether they laid the eggs on the upper or under sides of the leaves. Those laid in my garden were nearly all on the upper surface, while those at Tilbury were mostly seen on the under surface.

The egg stage lasted with us ten days, and in one case seventeen, the larval stage from three to five weeks, and the pupal stage from seven to ten days in summer. One larva lived seven weeks and then died. A few larvæ existed for two weeks without any food and eventually transformed to adults after being fed.

To my surprise, one warm day in November, some dozen beetles came out of the ground and remained on the surface in a sluggish condition, but before nightfall they had buried themselves again. I dug up the ground in January and found they were all lying about

[a] Dry stalks, stubble.—Ed.

6 inches down in the soil. Although the land was lumpy, they had gone into the solid soil and did not shelter under the clods or stones. Certainly all those I kept passed the winter in the adult condition.

In my laboratory they came out of their winter quarters in March, but in the open not until April 17, and the last on May 4. Some early potatoes had been planted with them and they commenced egg laying on May 20. All these check specimens were then killed. One could tell at a glance from their dingy color that they were hibernating, and as none had appeared to my knowledge by that date at Tilbury it was hoped the measures taken by the board had been sufficient. On the contrary, the beetles had survived the rough usage, and fresh specimens were reported at the end of May on the same land. I went there on June 2 for the board and found the beetles emerging from the ground in small numbers, and was at once struck by the difference in appearance between them and those I had so recently killed at home. One could easily see that they were only just hatched, the elytra being soft and almost cream colored between the dark lines. One of the inspectors noticed them emerging from the ground that had been treated in the previous autumn with gas lime and paraffin.

There is not the least doubt that these specimens had just hatched from pupæ. As is well known, the pupæ, especially in light, friable soil like that at Tilbury, are found at a great depth, so that in this case neither the gas lime, paraffin, nor plowing had affected them. The land was only plowed to a depth of 10 inches and many larvæ may well have previously burrowed deeper than that and so have escaped harm.

We thus had the insect living in two ways with us during the winter, namely, as adults and as pupæ. The latter is, I believe, exceptional in America, although my friend, Doctor Howard, tells me it has been observed by Professor Smith.

Very few specimens were found in 1902 and these were dealt with by constant hand picking. During the last two years none have been seen at Tilbury, so that we may safely say that the energies of the officials in charge have been rewarded with success.

Another scare occurred in 1904, live specimens being taken to the Hereford Museum, but these had been brought over by a lady from the United States as curios, little knowing the penalty attaching to the introduction of the live insects into this country.

I think we may safely say that *Leptinotarsa decemlineata* does not now exist in this country, but that it can flourish to a remarkable degree has become a well-established fact.

One point of interest I may mention in conclusion—namely, that it soon found an enemy in Britain in the form of the larval seven-spotted ladybird (*Coccinella 7-punctata* Linn.). These larvæ are

normally aphis feeders, but I found quite a number at Tilbury, which were observed in several instances feeding on the Colorado potato beetle's eggs, devouring them most greedily; and I can not help thinking that they did much of the work in getting rid of the enemy. The eggs of this ladybird were deposited on the potatoes and were sent in, in many instances, as Colorado potato beetle eggs. They certainly present a general rough likeness, but can at once be told by their smaller size and paler yellow hue. The pupæ of this beneficial insect also bear a slight resemblance to those of the potato "bug" and have frequently been sent in as such. They are very much smaller in size, however, and could not be mistaken by an expert.

AN EXPERIENCE WITH HYDROCYANIC-ACID GAS AS A REMEDY FOR THE CIGARETTE BEETLE IN DWELLINGS.

By F. H. Chittenden and F. C. Pratt.

During the first week of September, 1904, two persons residing in the northeast section of Washington, D. C., complained of injury to furniture, rugs, and tapestry in their dwelling houses, submitting specimens of the larva and adult of the cigarette beetle (*Lasioderma serricorne* Fab.) as the cause of their troubles. The first householder was very fearful lest the insects would spread from the only room infested to others, including one containing a valuable library; and the other, a lady, was in an exceedingly nervous condition, brought about through her ineffectual struggles to evict the "bugs" from her domicile. Gasoline, benzine, "black flag," and various other insecticides, including formaldehyde, had been used without avail, as had also red pepper. The insects were believed, and with reason, to have fed and multiplied on the last-mentioned substance.

As no experiments had hitherto been made with the hydrocyanic-acid gas treatment for this insect, experiments were instituted in the second house. A visit to this house showed injury plainly visible on the upholstered furniture, and the edges of a carpet were frayed. Numbers of beetles and their larvæ were observed, the last in cells preparatory to pupation.

Experiment No. 1.—The gas was used at the usual strength—1 ounce of cyanide of potash to 100 cubic feet of space, the doors and windows being quite securely closed. The exposure was seventeen hours. Upon aerating the following morning many beetles were found apparently dead on the floor and were swept up and kept in a box to ascertain if they might revive. All died, however, and the result was looked upon as satisfactory.

Experiment No. 2.—About two weeks later more adults were noticed about the house, and as they continued to accumulate notice

was given to this office, and a stronger test was recommended, three times the usual strength—that is, 3 ounces of cyanide of potash to 100 cubic feet of space—and a longer exposure. This was applied September 28, and renewal was made the following day, twenty-three hours later, arrangements having been made so that jars containing fresh acid could be introduced and charged with cyanide through a window. The second exposure lasted nineteen hours, or practically forty-two hours in all.

Prior to experiment it was ascertained that the insects had been breeding in the lower covering of the chairs. Dozens of larvæ were found between the covering and the webbing which was nailed across the latter.

After airing the infested room hundreds of larvæ were observed that had fallen from the lower covering of chairs (which had previously been ripped off to facilitate the effect of the gas) to the floor, and all adults observed were dead, as were also house flies. Some of the larvæ and beetles which had been subjected to treatment were placed in a vial to determine the effect of the experiment. They all died, but considerably later it was found necessary to dispose of the chairs, as they were still infested.

Owing to the failure of our first experiment with hydrocyanic-acid gas against the cigarette beetle, as also of another experiment on the confused flour beetle (*Tribolium confusum* Duv.), it was suspected that something might be wrong with the ingredients, and accordingly a sample of cyanide of potash was selected at random and submitted to Mr. J. K. Haywood, of the Bureau of Chemistry, for analysis. He reported that it contained 37.18 per cent cyanogen, 9.57 per cent chlorine, and the remainder a mixture of potassium and sodium, the analysis showing that this sample was not the product paid for; in other words, not 98 per cent potassium cyanide, but a mixture of potassium cyanide, sodium cyanide, and sodium chloride. The three compounds were present in such proportions that the mixture yielded 93 per cent of the amount of hydrocyanic-acid gas it should yield if the sample were pure potassium cyanide, and yet the amount of cyanogen which might be produced by this mixture could be 53 per cent, whereas in pure potassium cyanide it is 40 per cent.

In the second test against this species the potassium cyanide was used three times as strong as in the first. In the meantime, a sample was being analyzed by Mr. J. K. Haywood. His results were as follows:

	Per cent.
Potassium cyanide	51.70
Sodium cyanide	2.07
Sodium chloride	3.89
Potassium carbonate	39.28
Other impurities	2.76
Moisture	0.30

This analysis showed that the sample on treatment with sulphuric acid yielded only 54.50 per cent of the amount of hydrocyanic acid demanded by theory for pure potassium cyanide. An examination of the residue from the sample after treatment with sulphuric acid was also made, and it was found that the blue color of this residue appeared to be due to Prussian blue (ferric ferrocyanide), a compound left in the mixture by a faulty method of manufacture.

Mr. Haywood also made an examination of two samples of flour which had been treated with hydrocyanic-acid gas October 11 for *Tribolium confusum*, with the result that no traces of the acid were to be found in either sample, showing that the flour is not affected in any way by this method of fumigation.

NOTES ON FULLER'S ROSE BEETLE IN 1904.

By Fdk. Maskew, *Long Beach, Cal.*

The following notes are compiled from observations on Fuller's rose beetle (*Aramigus fulleri* Horn) made by the writer during the season of 1904 in Los Angeles County, Cal.

Throughout the month of May larvæ of all sizes were abundant in the infested berry fields, both in the strawberry plants and in the surrounding soil. The greatest depth at which larvæ were found in the strawberry fields approximated 5 inches. In the case of blackberry and logan berry they were found attacking the roots at a depth of from 15 to 18 inches.

May 23, in the soil surrounding a strawberry plant, the first pupa was found. This plant, while wilted, was still green, and contained no grubs in the borings in the stem. The writer was unable to estimate the depth at which the pupa was found, since it came up in a trowel full of loose soil.

June 17 the first beetle was noticed. It was feeding on the foliage of an ornamental shrub, *Lagunaria pattersonii*. During this month beetles became numerous.

July 29 the writer was asked by a local nurseryman what was the matter with a large potted ornamental asparagus (*Asparagus plumosus nanus*). The plant presented a very sickly appearance, the stems being hard and dry, and the foliage yellow. Finding no evidence of scale insects or mealy bugs, the roots were investigated, with the result that 84 larvæ and pupæ of Fuller's rose beetle were found in the soil and upon the roots contained in the 10-inch pot. The pot and plant had been suspended from the rafter of a lath house and had not been disturbed for eleven months.

August 19 a beetle was observed in the act of ovipositing. The eggs, 26 in number, were laid in an irregular mass upon the upper surface of the foliage of a crested wattle (*Albizzia lophantha*), a potted

plant. The foliage was about 5 feet above the ground, and above the egg mass it was drawn together and fastened by a webby substance. These eggs, placed in a phial and carried in the pocket, hatched August 24. Many egg masses were subsequently found and hatched out.

The beetles were very numerous and destructive during the months of August and September on ornamental trees and plants in the nursery yards, no plants except different species of Auricarias being exempt from attack. They appeared to eat the foliage of the castor bean with as much gusto as that of the Lima bean, and the pungent flavor of the young growth of the camphor, pepper, and the different eucalypti apparently suited their palates equally as well as the succulent young growth of canna. They were repeatedly taken at work on these plants. The foliage of all species of acacia for sale here is greedily eaten, excepting perhaps *A. cultriformis* and *A. armata*, and the writer has seen the market value—$2.50—of potted camellias and *Sterculia acerifolia* destroyed by these pests in twenty-four hours.

While at Oceanside, San Diego County, September 9, the writer noticed, in the orchard of the Rev. Mr. Dodd, a large number of insect castings on the foliage. While searching for the cause, an immature and apparently sound apple dropped to the ground. An examination showed that its stem had been freshly severed by some insect. Mr. Dodd, on having his attention called to this, stated that he had found a brown beetle eating the stems, and upon investigation the writer traced the injury to Fuller's rose beetle, the culprit being found at work in several instances. Time was very limited here and no opportunity was offered of studying this interesting phase of the subject.

This insect, in all of its stages, has been found by the writer, from Carpinteria, Santa Barbara County, to El Cajon, San Diego County.

THE GIANT SUGAR-CANE BORER.

(*Castnia licus* Fab.)

By C. L. Marlatt.

The appearance of an important new sugar-cane pest in Demerara, British Guiana, has some interest for us, inasmuch as the West Indian sugar-cane borer, also known as the "larger cornstalk-borer" (*Diatræa saccharalis* Fab.), for many years an important enemy of cane and corn in the United States, traveled northward through the West Indian Islands from the same region, reaching Louisiana at an early date and now ranging as far north as Virginia and Maryland.

That this new cane insect may come north seems doubtful, as the family to which it belongs is essentially tropical. While belonging to an entirely distinct family, the habits of this new cane pest closely par-

allel the older and better-known enemy of this staple. The adults, larvæ, pupæ, and eggs of this insect, together with canes showing the larval burrows and containing the larvæ, were transmitted to Col. G. B. Brackett, pomologist of the Department, by Mr. B. Howell Jones, of Georgetown, Demerara, who gave a rather interesting account of it in a letter which is quoted below. The insect proved to be *Castnia licus* Fab., and the only known food habit hitherto recorded is the breeding of the larvæ in the Upper Orinoco in the roots of an orchid. As shown in Westwood's Monograph of the genus Castnia (Transactions of the Linnæan Society, 2d series, Zoology, Vol. I, p. 173, 1875, and by Herbert Druce in his Lepidoptera-Heterocera (Biologia Centrali Americana, Vol. I, p. 26, 1883), this insect has been collected in Nicaragua, Costa Rica, Ecuador, east Peru and Bolivia, Guiana, Trinidad, Amazons, and Brazil. According to Druce, it is a scarce insect in Central America, but seems to be more abundant in its more southern range.

The material sent by Mr. Jones was so ample and in such an excellent state of preservation that it seemed worth while to have careful drawings made, which are reproduced for this note. (Pl. IV.) The large size of this insect, in comparison with *Diatræa saccharalis*, commonly known in this country as the "larger cornstalk-borer" to distinguish it from the smaller cornstalk-borer (*Elasmopalpus lignosellus*), warrants the application of the term given at the head of this article to this new cane pest. The assumption of the cane-feeding habit by this insect is another illustration of the sudden development of an injurious food habit in an insect which for years has had no economic importance, and shows how little can be predicted of any insect from its known food habits. It is to be hoped that this insect will not develop a northern trend through the West Indies as did its forerunner, the larger cornstalk-borer. The fact that it is not especially abundant in its northern range in Central America is an element of security, but can not necessarily be relied upon, because this scarcity may be due to a lack of suitable plants in which it can breed. Mr. Jones's letter is a most interesting contribution to the knowledge of the history of this insect, and it is significant that now that it has found a food plant furnishing abundant means of reproduction it breeds in enormous numbers. I quote the letter referred to in full:

GEORGETOWN, DEMERARA, BRITISH GUIANA,
November 28, 1904.

G. B. BRACKETT, Esq.

DEAR SIR: I am taking the liberty of sending you a small box containing the eggs, caterpillars, chrysalis, and butterfly that has been doing some damage to some of our cane fields. It is entirely new to us here, though some planters say they have seen it before, but they did not think it did much damage. In the present case it is doing a great deal of damage, and a few children with nets

CASTNIA LICUS FAB.

a, Female moth; *b*, larva, lateral view; *c*, first abdominal segment with proleg; *d*, egg; *e*, pupa, ventral view; *f*, pupa, dorsal view; *g*, spiracular cleft; *h*, abdominal segment, enlarged to show rows of reflexed spines; *i*, segment of cane showing larval burrow and larva—larva, pupa, and moth natural size—egg and anatomical details variously enlarged—cane one-half natural size (original).

have caught upward of a thousand of the butterflies in a week. At present the attack is confined to one estate, but, of course, it may spread. This is the third year it has been noticed. In the two first years comparatively slight damage was done, but at present time a great deal of damage has been done. The caterpillars enter the cane both from the bottom, close to the root, and work upward through four or five joints, or enter above and work downward, forming a chrysalis at the bottom of the cane or in the ground at the base of the cane. The caterpillars appear in October and November, and, as this is our chief reaping season, many of them are destroyed by the mill. They have been found in fields of loose vegetable soil which have been top-dressed with filter-press refuse.

My object in writing to you is to ask you if you would put this before the entomologist of your Department to see if the butterfly is known, and to ascertain its name, if it is. It also might be interesting to those engaged in studying the cultivation of sugar cane and the disease from which it suffers.

Hoping I am not giving you too much trouble and trespassing on your kindness, believe me, yours faithfully,

B. Howell Jones.

In a subsequent letter, under date of February 2, 1905, Mr. B. Howell Jones gives the additional information that the plague of these insects still continues on the Enmore estate and many thousands of the moths are being caught weekly. He says the only remedies so far practiced are catching the moths and destroying the grubs when found. An attempt to attract the moths by putting a strong light in the fields at night was without success.

SYSTEMATIC RELATIONSHIP AND DESCRIPTIVE NOTES.

The family Castniidæ, to which this insect belongs, includes a considerable number of very showy and large moths limited to the neotropical region and more abundant in South America than in Central America and Mexico, one species, however, having been reported in the United States. The systematic position of this family has been the subject of some controversy among specialists. On account of the clubbed antennæ and general showy character of the moths they were originally assigned to the Rhopalocera and to the genus Papilio. The discovery of the larvæ and pupæ and something of the habits of some of the species has led to more correct ideas of their relationships. In larval and pupal characteristics one is reminded of Cossus. The examination of the material submitted by B. Howell Jones to Doctor Dyar led him immediately to place them in the family Tineidæ—an anomalous disposition in view of their great size, but warranted by evident structural characters. The habits of but few species of this genus are known, and these agree in being internal feeders, and this is probably true for all. In this particular species pupation occurs within the larval burrow. Other species, however, leave the burrow and form loose cocoons. The following brief description of the

different stages is appended, not as a technical contribution, but as supplemental to the plate:

Adult.—The wing expanse of the adult female is 3 to 4 inches. The male is smaller, having a wing expanse of $2\frac{3}{4}$ to 3 inches. Considerable variation is exhibited in the ornamentation of the wings, two distinct varieties being illustrated in the material in the National Museum. The general color is rusty brown. The forewings are crossed with a broad diagonal white band; the posterior wings have a similar band, broader and less sharply defined, crossing them at right angles to the band of the forewings. The hindwings have also a submarginal row of 6 or 7 reddish-yellow spots, the central spots being much larger than the lateral ones. A variation in coloration, as in the example figured, is seen in some specimens in the presence on the forewings of an additional irregular row of spots forming a band exterior to and irregularly parallel to the broad transverse band. The notable feature of the wings is the brilliant opalescence, especially notable near the body. The antennæ are clubbed, giving them a resemblance to the true diurnal Lepidoptera. The under surface is lighter than the upper, with the markings approximately repeated and rather more distinct save for the yellow spots, which are faint. There is also an additional submarginal row of white spots on the anterior wings.

Larva.—The larva, illustrated on Plate IV, figs. *b* and *c*, varies from 2 to $2\frac{1}{2}$ inches in length, is white or flesh-colored, and very elongate. The head is relatively small and pointed, of a light chestnut, with mandibles and more or less of mouth parts black. The body is smooth and practically devoid of hairs, although minute ones which have significance in classification are found, as indicated in the drawing. The prolegs bear two transverse rows of stout curved spines or hooks. The spiracles are very large, oval, prominent; the prothoracic pair and the pair on the last abdominal segment are about twice the size of the others.

Pupa.—The pupa (figs. *e* and *f*) measures an inch and a half in length, is fairly robust, chestnut brown in color, and in general smooth and shining. There is a strongly excavated crescent-shaped spiracular pocket on either side of the pronotum. The prominent features are the two transverse rows of strong reflexed spines, or teeth, on the dorsum of each of the abdominal segments extending laterally, a little beyond the spiracles. The anterior row of spines is much stronger than the posterior, and the latter is wanting or nearly so on the two terminal segments. The tip of the pupa is squarely truncate and ornamented with a series of sharp ridges.

Egg.—The egg (fig. *d*) is flesh colored, white when empty, very elongate, and with five strong carinæ, giving in cross section the

stellate figure shown in the illustration. Length, one-sixth of an inch.

The segment of cane showing the characteristic larval burrow with larva in situ (fig. *i*) was drawn from one of the canes sent by Mr. Jones. The pupa is formed in a little cell similar to that occupied by the larva in the cane.

GENERAL NOTES.

REPORTED SUCCESS OF AN INTRODUCED LADYBIRD SCALE ENEMY IN CALIFORNIA.

Under date of September 28, 1904, Mr. Frederick Maskew, Long Beach, Cal., sent specimens of the introduced ladybird beetle, *Rhizobius lophantha* Blaisdell, with the statement that it has very effectually controlled the purple scale (*Mytilaspis citricola* Packard) in the Chula Vista lemon orchards during the year, this report being based upon testimony furnished by Messrs. Allen and Copeland, extensive growers and competent close observers. Our correspondent's personal experience with this ladybird was limited to the lemon orchards of Pacific Beach. Reviewing his long acquaintance with the purple scale in the seedling orange orchards of Los Angeles County, his findings were highly gratifying. He reports as follows:

> Old purple scale were abundant on most of the trees, but were in every instance dead, the eggs having apparently all hatched. The most diligent search failed to find any live young scale on either wood, foliage, or fruit. At the time of this investigation, September 7, the parasites were found only occasionally, but I was assured that they had been very numerous during the past year.
>
> Knowing the vagaries of the different Rhizobiids, I am inclined to look upon these results in San Diego County as an adaption to local food supply, induced by the absence of other forms due to extreme drought rather than a case of true parasitism.
>
> This same beetle is very generally distributed throughout Los Angeles County, and I have often found it in very singular locations. It has attracted much attention during the past year and has been identified by different local "authorities" as *Rhizobius toowoomba*, *Scymnus marginicollis*, *Scymnus lophantha*, and *Rhizobius debilis*.

In commenting on the identity of these species, Mr. E. A. Schwarz of this office furnishes the following notes:

> *Rhizobius toowoomba* Blackburn is a synonym of *Rhizobius lophantha* Blaisdell.
>
> *Rhizobius debilis* Blackburn is closely allied, but a little larger, more metallic, and with darker prothorax and darker underside of the body.
>
> *Scymnus marginicollis* Mannh. is entirely different from Rhizobius, yet is frequently mistaken for *Rhizobius lophantha*. It is a native of California, and feeds, both as larva and imago, on plant lice that affect various fruit trees and many herbaceous plants. It never feeds on scale insects.

It is claimed that *Rhizobius lophanthæ* was probably in California some years before it was introduced by Albert Koebele from Australia, having evidently been introduced accidentally. It was noticed among the mountains north of Pomona, Cal., in 1891, and in San Diego the following year. Some notes on this and related species have been furnished by Prof. John B. Smith in an article entitled "Scale Insects and their Enemies in California," published in Bulletin No. 6, n. s., of the Division of Entomology, pages 46–48. There can be no doubt that the effectiveness of some of these ladybirds has been handicapped by the somewhat careful methods followed by growers of citrus fruits in California in spraying and fumigating scale-infested orchards. Nevertheless, it is extremely doubtful if any of these ladybirds, after having once obtained a foothold, could be exterminated by fumigation or spraying, as some affect to believe. If any species have died out, it has probably been due chiefly to natural causes, such as insect and other enemies, and climatic conditions deleterious to their development.

LOCUSTS, MALARIA, AND MOSQUITOES IN THE TRANSVAAL.

We have just finished a most successful locust campaign. I do not know how many swarms of locusts we have killed, but it will evidently run into thousands. In one little valley about 20 miles wide and 20 miles long our official force killed about 1,500 swarms, varying in size from 10 by 12 feet up to swarms occupying an area of 5,000 square yards. In this valley there were also 30 farmers working on their own farms, and I would not care to estimate how many locusts were killed. From evidence given by old residents and by the natives I find that this has been one of the worst locust years in their memory. They all agree that if these swarms had not been destroyed nothing would have been harvested in this locality, whereas at present all the damage could be easily compensated by a $5 note. The Kaffirs are especially keen on this question of destruction, and have turned out in hordes to aid the district locust officer. Our success in this valley is one of the many successes which we have had throughout the infested districts of the colony. We are placing our main reliance upon a strong arsenical spray. The spray consists of 1 pound of arsenic, half a pound of carbonate of soda, 1 pound of sugar, and 10 gallons of water. These chemicals are boiled together so as to make the solution arsenite of sodium, which is sweetened by the sugar. In order to show you how effective this is, I need only cite one instance of a farmer who noted a swarm of fully grown "voetgangers"—that is, grasshoppers in their last stage before obtaining wings—which was 200 yards long and 50 yards wide. These locusts were advancing down a hill toward his "mealies." (The term

"mealies" is used in this country instead of corn.) This swarm was so numerous that it stopped a railway train, the latter being obliged to go back several times before it could cross it. The farmer sprayed a semicircle about 60 feet wide in front of the swarm, using the arsenical spray. As a result not a single locust escaped. It seems that the sugar in the spray has a great attraction for them, and they eat their fill of it to their utter destruction.

As to the prevalence of malaria on our eastern line of railway, we have at last succeeded in awakening the railway people to the seriousness of the situation. Next Tuesday we expect to start on a mosquito survey of about 150 miles of railway, in cooperation with one of the railway medical officers. I shall make accurate surveys of the breeding places and the kinds of mosquitoes found, while the doctor will make blood studies of the inhabitants, including the natives, horses, sheep, goats, birds, and other animals. We are being furnished with three cars—one for living purposes, one for a laboratory, and one for kitchen and dining room. If I am not mistaken, I think that this is the first time that any entomologist ever had the opportunity of conducting studies of this character under such favorable circumstances.—C. B. Simpson, *Entomologist, Transvaal Department of Agriculture, Pretoria, Transvaal, South Africa.*

THE CATERPILLAR OF ANTICARSIA GEMMATILIS INJURING VELVET BEAN.

October 8, 1903, we received from Mr. A. Fredholm, Fort Drum, Fla., numbers of the caterpillars of the Noctuid moth, *Anticarsia gemmatilis* Hbn., found on velvet beans (*Mucuna utilis*). We have also received a communication relative to the great injury accomplished by this species in Florida (localities not stated). The insects were stated by Mr. John Parker to occur in great numbers and to destroy the vines by entirely denuding them of their foliage. Mr. Parker thought that several generations were produced each season, as they appeared to be well-nigh continuous breeders. The larvæ are exceedingly active, and at the slightest disturbance jump to the ground, where they wriggle about rapidly until a place of security is found.

Blackbirds and rice birds eat them, but the insects are often too nimble for the more clumsy birds and many escape. When, however, the birds are in large flocks, as frequently happens, they must undoubtedly be of service. The "green sparrow" was said to be the most active as well as successful enemy of the larvæ. These birds, however, do not occur in great numbers, but one of them would get in under a vine and pick off larva after larva. The larvæ remain on the under sides of the leaves.

The velvet bean is highly recommended for winter pasturage in the extreme South, for hay, and for soil renovation; it is also used as a nitrogen gatherer in orange groves. The occurrence of this insect,

according to Mr. Parker, is the principal drawback to the extensive planting of the velvet bean in that section for either winter pasture or hay, as it leaves no foliage on the plants to be fed to stock or to be cured, nor, in fact, vegetation to plow under for fertilizing. For several years velvet beans have been planted, and invariably the caterpillars alone were benefited. Many fields and a small grove have been badly damaged. In the groves 50 to 60 per cent of the plants were injured; in open fields injury was still greater.

Our correspondent had heard of several complaints of this caterpillar destroying velvet beans. A Mr. J. A. Willis, Alger, Fla., had had his crop ruined for several years.

The caterpillar of this species is long and slender, cylindrical, the last pair of legs projecting backward and spreading. The body is sparsely coated with rather stiff black hairs which arise from small white button-like tubercles. The head is large, a little wider and higher than the body, rounded, and with a slight notch in the middle. The head is orange yellow or greenish yellow with a few small blackish dots. The general color of the body varies from dull green to olive brown, which becomes yellow in inflated specimens. It has a number of fine white lines, one dorsal, two lateral—separated by a blackish shade—and a distinct yellow and white pair along the stigmata or breathing holes, with a little dark edging below. It has eight pairs of legs. The mature larva measures about one and one-half inches in length, and one-sixth inch in width. Altogether it is an attractive species, as will be seen by the illustration (fig. 20, *b*). The character of the head and the arrangement of the stripes on the sides of the body are shown at *c* and *d*, respectively.

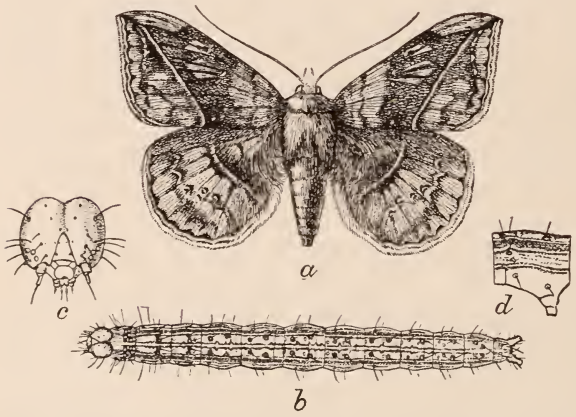

FIG. 20.—*Anticarsia gemmatilis*: *a*, moth; *b*, larva, dorsal view; *c*, head, seen from front; *d*, first abdominal segment, lateral view—*a*, *b*, enlarged; *c*, *d*, more enlarged (original).

The moth is also ornamental in spite of its somewhat somber colors—dull brownish gray with darker brown shades arranged as shown in the figure at *a*. The body is stout and narrowed to the apex. The expanse of the fore-wings is about one and one-half inches.

If the velvet bean should come into general use in Florida and neighboring States, the extermination of this caterpillar is apt to

become a matter of considerable economic import. Doubtless the youngest caterpillars of the first generation could be readily reached by means of a spray of Paris green, arsenate of lead, or other arsenical, and this would have the effect of greatly reducing the insect for future generations, provided the work is carried on thoroughly. Or the arsenical could be distributed dry, as used against the cotton worm, by shaking it from bags fastened to each end of a board or pole and carried by a man mounted on a mule or horse. Later generations of the caterpillars will be apt to be more numerous and more difficult of treatment on account of the difficulty of placing the poison where all of the caterpillars will be reached.—F. H. C.

AN INSTANCE OF COMPLETE PARASITISM OF THE IMPORTED CABBAGE WORM.

A number of maturing caterpillars of *Pieris rapæ* were gathered at Washington, August 28, 1904, to ascertain what percentage might be parasitized at this time, as many were obviously injured. Sixty per cent of all that could be found in the last stages developed parasites of the imported Braconid *Apanteles glomeratus* Linn., all of which issued in masses of cocoons from their host within two days after the latter were taken under observation. The remaining caterpillars all transformed to pupæ and thereafter to perfect butterflies.

During the first week of September another lot of these cabbage "worms" was obtained from cabbage and other cruciferous plants from our experimental garden, all of the mature individuals that could be secured. These were counted and cared for in the same manner as before, and toward the end of the first week it was noticed that not a single larva had survived. No pupæ were formed, and therefore no butterflies issued, and since a mass of Apanteles cocoons was counted for each caterpillar that had been gathered, a case of complete parasitism was proven. As soon as it was noticed that the caterpillars had failed to pupate, both larvæ and pupæ were sought for on the grounds, but with negative results, showing that the same condition existed both in rearing jars and in the open.

The cocoons of *Apanteles glomeratus* were counted and found to vary from 30 to 35 to a mass; in other words, a full-grown caterpillar usually harbors about this number of parasites. A secondary parasite was observed issuing from a comparatively small proportion of the Apanteles cocoons. In one instance the Apanteles and the secondary parasite, a chalcidid, *Tetrastichus microgastri* Bouché, and an introduced form like the primary parasite and its host, were in equal numbers. In another case the proportions were 13 to 40. The usual number of secondary parasites was 2 to each primary parasite, but in some cases 3 of the secondary parasites must have issued from a single cocoon.—F. H. C.

SPREAD OF THE MEDITERRANEAN FLOUR MOTH IN PENNSYLVANIA.

March 15, 1905, we received specimens of the Mediterranean flour moth (*Ephestia kuehniella* Zell.) in different stages from a correspondent in Montgomery County, Pa. The insect was reported to have given no end of trouble since it arrived in some corn about a year before. The injury was of the characteristic form due to the construction of webs in the flour, in spouts, elevators, and reels, which prevented the stock from running. It was necessary to remove bolting cloths from reels, and to take out elevator belts and clean them. The fact was noted that the stock in the elevators and reels is kept so warm from grinding that the insects breed nearly as rapidly in winter as in summer. The insect was accompanied by the confused flour beetle (*Tribolium confusum* Duv.).

The recent very rapid increase of this flour moth has been already noted in the Yearbook of this Department for 1904, page 603.

TUSSOCK CATERPILLARS IN FLORIDA.

March 22, 1905, we received word from Mr. E. Neve, Tampa, Fla., that an army of caterpillars had made their appearance in that city and in several localities in the suburbs, stripping oak shade trees of every leaf, and spreading to other plants, even invading houses by entering the windows, crawling over porches, and climbing walls. Some persons claimed that the caterpillars stung them, causing ugly sores, and it was feared that the orange groves in the vicinity of the city would be infested. The insect concerned in this case is one of the tussock caterpillars, *Hemerocampa inornata* Beut., a near relative of the better known northern white-marked tussock caterpillar, *Hemerocampa leucostigma* S. & A.' The soreness complained of was the result of the irritating action of the hairs of the caterpillars on the delicate surface of the skin, particularly on the neck and back of the hands.

A SQUEAKING SPHINX CATERPILLAR.

September 20, 1904, Mr. A. C. Wharton wrote us of a large caterpillar which he had taken at Port Gibson, Miss. It was described as over 2 inches in length, of a pale greenish blue color, and armed at the posterior extremity with a rather stout spine curving backward. On capturing it with his fingers he was surprised to hear it emit a distinct sound resembling the squealing of a very young mouse. The sound was faint but quite distinct at a distance of 2 feet. The species was identified by Dr. H. G. Dyar as *Cressonia juglandis* S. & A., who states that this species always "squeals" when seized, from which fact it is quite generally known as the squeaking sphinx.

The caterpillar of the death's-head moth of Europe, *Manduca atro-*

pos Linn. (better known in literature as *Sphinx atropos*), makes a hissing or, more correctly, crackling sound which seems to be produced by the rubbing together of the mandibles or jaws, each of these being provided on its outer surface with a row of prominences serving as a stridulating organ. The sound is not unlike that made by the discharge of an electric spark or the snapping of the finger nails together. Sometimes the sound is continuous and resembles that made by winding a watch. The death's-head moth itself also makes a sound, which has been compared to the squeak of a mouse. There has been wide difference of opinion as to the manner in which these sounds are produced, and the reader is referred to Tutt's British Lepidoptera, Vol. IV, pages 444–453, where the matter is treated in detail. The pupa, shortly before emergence, is capable of emitting a sound similar to that of the moth, although fainter.

A JUMPING GALL.

July 6, 1904, Dr. Morris Gibbs, Kalamazoo, Mich., sent a number of galls found underneath oak trees. When received nearly all of the specimens were jumping about in a very lively manner and to a considerable height for such small objects. Their motions are considerably different from those of the better-known jumping bean, which are caused by a lepidopterous larva similar to the codling moth, and known as *Carpocapsa saltitans*. These galls occur at the rate of a thousand to a single leaf, and are formed on the under surface of different species of oak. They have at first glance the appearance of a clover seed, having an average diameter of only 1 mm. Closely examined they are found to resemble a miniature acorn. The insect which produces this gall is a cynipid fly, *Neuroterus saltatorius* Hy. Edw., a common species, reported from Ohio to Michigan and Missouri and westward to California. It has been surmised that the peculiar bounding motion of this gall is caused by the larva within, whose motion is similar to the leaping of the cheese skipper (*Piophila casei* Linn.). A technical description of this gall was given by Riley in the Transactions of the Academy of Science of St. Louis (Vol. III, p. cxci). The same writer also mentioned this species on page 142 of the Annals and Magazine of Natural History, Vol. XII, fifth series, 1883.

THE GREAT ELM LEAF-BEETLE.

(*Monocesta coryli* Say.)

During the past two years injury by this species, which is ordinarily rare, has been observed in Virginia. September 21, 1903, Prof. William B. Alwood, Blacksburg, Va., wrote of damage by this

beetle and its larva at Manassas Gap. It was feeding on red elm, and in one case utterly defoliated a tree 16 or 18 inches in diameter. July 25, 1904, Mr. W. C. Davis sent specimens in the egg, larval, and adult stages found on elms which were being injured at Rockbridge Baths, Va.

A good account of this species, with descriptions of its various stages, was published in the Report of the Entomologist for 1878 (Report of Commissioner of Agriculture, pp. 245–247, Pl. IV), which includes illustrations of the different stages, with a very brief account of the life cycle, the impression evidently being that the insect was single-brooded. It was stated that "toward the end of July and early in August the worms cease feeding and descend into the ground, burrowing therein and forming a simple oval cavity a few inches below the surface. They lie dormant therein through the fall, winter, and early spring months, assuming the pupa state but about a week before the beetles issue." The experience of the present year indicates a possibility of two generations or a long generation due to a long egg-laying period, as the eggs received July 25 hatched before the end of the month and the first week of August, larvæ attaining full growth during the latter half of August.

August 27, 1904, Mr. Otto M. Von Schrader, Charlestown, Jefferson County, W. Va., sent specimens of the larva, none of which had transformed to pupa when received on the 29th.

By request Mr. Davis kept this species under observation, and August 24 sent specimens of the nearly mature larva, with leaves almost completely skeletonized. In regard to the possible occurrence of a later generation he wrote substantially that July 12 the beetles were very abundant, but by the 25th they had left many of the trees entirely. In our rearing cages the beetles remained well into the first half of August. At Rockbridge Baths a considerable number of egg clusters remained, although the number observed seemed out of proportion to the numbers of beetles, fair evidence that the beetles do not deposit more than two egg masses. August 1 the eggs began to hatch. Although the larvæ were not more abundant in the latter part of August, the damage accomplished was ten times greater, as they destroyed the leaves more rapidly and more thoroughly by skeletonizing them. They prefer the under surface of the leaves, as do nearly all of their kind. Often, however, they are found feeding on the upper surface, presumably when this portion is in the shade. They sometimes eat through the leaf, but normally skeletonize it. Many leaves turn brown and drop without showing any signs of having been touched by the beetles.

THE MALODOROUS CARABID, NOMIUS PYGMÆUS DEJ., IN OREGON.

From time to time we have had occasion to mention this offensive little ground beetle and its occurrence in various portions of this country, from the Pacific coast to Michigan. August 20, 1904, Messrs. Woodard, Clarke & Co. called attention to an invasion in Portland, Oreg., where the insect was the occasion of unpleasant comment on the part of those who were so unfortunate as to be obliged to work in the vicinity of the bugs. Considerable expense was incurred in the payment of plumbers' bills for efforts to locate dead rats which failed to materialize, and employees of the firm feared typhoid fever, and were loath to remain at their post of duty. Our correspondents stated that there was no evidence that these beetles were dependent on extraneous influence or disturbance as a cause for their emitting the odor. They watched very carefully around a drain pipe on the lower roof, and the beetles seemed to emit the odor at all times. It was believed that their presence in numbers might be accounted for by dense forest fires which might have driven them from the woods and surrounding fields, the air being at times thick with smoke. This beetle is discussed more in detail in Bulletin No. 9, n. s., of this Bureau, pages 49–53.

REPORTED OCCURRENCE OF THE ASPARAGUS BEETLE IN CALIFORNIA.

During December, 1904, we received word from Mr. R. E. Smith, plant pathologist at the University of California Agricultural Experiment Station at Berkeley, Cal., reporting that the common asparagus beetle (*Crioceris asparagi* Linn.) now occurs quite commonly in that State in certain localities, and that it is becoming a serious pest. It was, he writes, observed incidentally in connection with asparagus rust, and growers were satisfied that they had seen the insect only within recent years, and that it seemed to have come at about the same time as the rust, which has been prevalent since 1901 or 1902. It is not as yet generally distributed over the State. No specimens of the species appear to have been seen by an entomologist, hence some doubt attaches to this report.

THE SCIENTIFIC NAME OF THE PLUM GOUGER—A CORRECTION.

There has been so much confusion in regard to the scientific name of the plum gouger, particularly since the appearance of our note on this subject in Vol. II of Insect Life (pp. 258, 259), that it seems desirable to bring the matter up again. As long ago as 1876 Le Conte wrote, in his Rhynchophora of North America (p. 194) that *Anthonomus prunicida* Walsh., which was originally described in the

Prairie Farmer for 1863, and redescribed in the Proceedings Boston Soc. Nat. Hist. (Vol. IX, p. 309), was a synonym of *A. scutellaris* Lec., the latter having been described in 1858 (Proc. Acad. Nat. Sci., Phila., p. 79), thus antedating Walsh's name. In Doctor Dietz's revision of the Anthonomini (Trans. Am. Ent. Soc., Vol. XVIII, 1891, p. 191) this point of synonymy is only briefly mentioned on the authority of Le Conte. Until the appearance of the note in Insect Life quoted above, Henshaw, in his Bibliography of Economic Entomology, corrected this synonymy in accordance with Le Conte's views; but in consideration of the facts that Dietz did not see specimens of *A. prunicida* Walsh, and that many are still in doubt concerning the right name to use, some further elucidation of the matter seems desirable. We have therefore asked the opinion of Mr. E. A. Schwarz, custodian of the coleoptera of the National Museum collection. He reports that there is in the museum a specimen in the handwriting of Walsh and from the old Riley collection, labeled *prunicida*, which agrees with the description and specimens of *scutellaris* of Le Conte as accepted by systematists.

Therefore the true name of the plum gouger is *Anthonomus scutellaris* Lec. As to *Coccotorus scutellaris* Lec., the name Coccotorus is treated as a subgenus by Dietz.

Mr. C. F. Baker mentions an *Anthonomus scutellaris* reared in great numbers from wild plums in Colorado (Entom. News, Vol. VI, 1895, p. 29), which may belong to this same species or to *A. hirsutus* Bruner, recorded, so far as we know, only from Nebraska (West Point) and on a single food plant, *Prunus pumilo*. Hence the note by Bruner in Vol. I, Insect Life, page 89, really refers to his new species, *hirsutus*, and the figure there used should be continued for *scutellaris* in preference to the two figured in Vol. III of the same publication, neither of which is quite correct.

UNUSUAL FOOD PLANTS FOR THE SQUASH LADYBIRD.

August 26, 1903, the writer found larvæ of *Epilachna borealis* Fab. about two-thirds grown feeding on leaves of muskmelon, beans, and *Ambrosia artemisiæfolia*. These larvæ were kept in separate breeding cages and reared to maturity. They fed freely on the plants on which they were found, pupated at about the same time, and the pupal period was practically the same—eight to ten days.

There was no squash or pumpkin growing in the fields where these larvæ were found and no cucurbit in the field where those on bean and Ambrosia were taken. The muskmelon field was separated by shrubbery from the bean field.

It is, however, extremely doubtful if this species could develop from egg to adult on any other than cucurbits.—E. S. G. T.

NOTES ON ORTHOPTERA COLLECTED ON SUGAR BEETS IN 1904.

During a trip through portions of the sugar-beet growing sections of the United States made in May and June and in September and October, 1904, a number of Orthoptera were collected, and these have recently been identified by Mr. A. N. Caudell, of this Bureau. Only those marked by a star (*) in the list have been previously reported on this crop.

Most of the Orthoptera taken the first trip were immature and could be identified at the most only to the genus. Nymphs identified by Mr. Caudell as belonging to "*Melanoplus atlanis* Riley or *M. femur-rebrum* De G." were found at Longmont, Colo.; Montrose, Colo.; Paonia, Colo., and Lehi, Utah, doing considerable damage to young beets. At Echo, Oreg., several species were captured feeding on beets adjoining an alfalfa field that had recently been cut. They had entirely defoliated the beets along the borders and in some places had advanced well into the field. At no other points were grasshoppers seen doing serious injury, though several of the beet growers complain of severe injury in years past.

The following is a list of the species identified:

Stipator minutus Thom.: Olney, Colo. (4 Oct.), 4 ♂.

Agencotettix scudderi Brun.: Lagrande, Oreg. (14 Sept.), 1 ♂; Spreckels, Cal. (20 Sept.), 2 ♀.

Circotettix occidentalis Brun.: Spreckels, Cal., 8 ♂, 3 ♀.

Gomphocerus clavatus Thom.: Longmont, Colo. (8 June).

Arphia pseudonitana Thom.: Fairfield, Wash. (10 Sept.), common.

Chortophaga viridifasciata De G.: Fort Collins, Colo. (1 Oct.); Longmont, Colo.

* *Dissosteira carolina* L.: Menominee, Mich. (5–6 Sept.); Daggett, Mich., (5 Sept.); Waverly, Wash. (10 Sept.); Fairfield, Wash. (10 Sept.); Lagrande, Oreg.; Echo, Oreg. (15 Sept.); Spreckels, Cal. (20 Sept.)—common at all places.

Dissosteira spurcata Sauss.: Waverly, Wash., rare.

Camnula pellucida Scudd.: Fairfield, Wash., common on high ground.

Sphragemon collare Scudd.: Menominee, Mich., rare in beet fields.

Trimerotropis juliana Scudd.: Lagrande, Oreg.

Trimerotropis n. sp.: Spreckels, Cal.; 2 specimens.

Trimerotropis vinculata Scudd.: Lagrande, Oreg., Echo, Oreg., Spreckels, Cal., Delta, Colo. (14 June), several.

Schistocerca venusta Scudd.: Echo, Oreg., rare.

**Melanoplus atlanis* Riley: Waverly, Wash., Fairfield, Wash., Lagrande, Oreg., Echo, Oreg., Spreckels, Cal., very common at all these places.

**Melanoplus bivittatus* Say: Menominee, Mich., Daggett, Mich., Fairfield, Wash., Waverly, Wash., Rocky Ford, Colo. (29 Sept.), Fort Collins, Colo., Olney, Colo. (4 Oct.), very common. At Olney was also taken 1 specimen of the brachypterous form.

Melanoplus devastator Scudd.: Spreckels, Cal., rare in beet fields.

**Melanoplus differentialis* Thom.: Menominee, Mich., Daggett, Mich., Olney, Colo., Rocky Ford, Colo., Manzanola, Colo. (3 Oct.), common.

Melanoplus femoratus Burm.: Fairfield, Wash.

**Melanoplus femur-rubrum* DeG.: Menominee, Mich., Daggett, Mich., Lagrande, Oreg., Echo, Oreg., Spreckels, Cal., Olney, Colo., common.

Melanoplus fordus Scudd.: Olney, Colo., 2 ♂, 2 ♀.

Melanoplus gracilipes Scudd.: Spreckels, Cal.

Melanoplus intermedia Scudd.: Spreckels, Cal.

Melanoplus lakinus Scudd.: Fort Collins, Colo., Olney, Colo., several.

Melanoplus marginatus var. *pauper* Scudd.: Spreckels, Cal.

Melanoplus tenuipennis Scudd.: Spreckels, Cal.

Melanoplus sp.: Fowler, Colo. (9 June), Longmont, Colo. (8 June), Fort Collins, Colo. (6 June), Montrose, Colo. (13 June), Delta, Colo. (15 June), Paonia and Hotchkiss, Colo. (14 June), Lehi, Utah (17 June), Byron and Durand, Mich. (29 June), all nymphs and very common.

Phœtaliotes nebrascensis Thom.: Lagrande, Oreg., Echo, Oreg.

Conozoa behrensi Sauss.: Echo, Oreg., Spreckels, Cal., common.

Xiphidium fasciatum (?) DeG.: Byron, Mich.

Cordillacris sp. (nymphs): Greeley, Colo. (2 June), Grand Junction, Colo. (12 June).—E. S. G. T.

A MEXICAN KISSING BUG.

Under date of September 12, 1904, Prof. A. L. Herrera, Comision de Parasitologia Agricola, Mexico, D. F., wrote that a large form of bug commonly known in that country as "chinche voladora," a specimen of which he furnished and which proves to be *Meccus pallidipennis*, Stål., is the cause of considerable apprehension of serious injury, especially to children which it attacks by puncturing the skin with the beak and sucking the blood.

The species is a reduviid, larger than our native so-called "kissing bugs," and is closely related to Conorhinus, the genus which includes the cone-noses, our most bloodthirsty species. It measures upward of 1¼ inches in length, and is five-eighths of an inch wide across the middle of the abdomen. It is black, with two triangular bands converging at the apex of the scutellum, while each segment of the connexivum or reflexed sides of the abdomen which border the tegmina is variegated with white, resembling the markings of certain of our common turtles. Its beak is a little longer than the elongate, pointed head. The insect is so large and of such formidable appearance that we would naturally expect it to be capable of a dangerous "bite."

HYDROCYANIC-ACID GAS AGAINST THE BEDBUG.

March 17, 1905, Rev. Ruter W. Springer, chaplain, U. S. Army, Fort Washington, Md., states that he has used the hydrocyanic-acid gas process for the extirpation of the bedbug in the barrack buildings of that fort with considerable success. He reports as follows:

> The experiment was first tried in a large barrack building, according to directions. Several receptacles were broken in mixing the acid, but the intended results were perfectly satisfactory. Since then my own residence was twice invaded, beyond the reach of ordinary remedies. In each case the effort at relief was perfectly successful. The last time a half a dozen insects were cap-

tured and placed in a glass. The glass was thoroughly wrapped up in a folded sheet, then in a pair of blankets, and then in a quilt. At the close of the experiment these insects were all found dead. As to pasting up cracks, I discovered that inch strips of newspaper, soaked for some time in water, and patted into place with the hand, would make an excellent gas check for any reasonable length of time, and afterwards would come off easily without requiring hours of labor

SINGULAR INCREASE OF "LERP" ON TREES OF THE "YELLOW BOX."

When traveling on the train between Melbourne and Macedon, I noticed a patch of probably some hundreds of acres of land on which the trees of *Eucalyptus melliodora* appeared to be covered with snow, but which on close inspection proved to be an enormous number of the lerp insect (*Lasiopsylla rotundipennis* Frogg.), covering the leaves so closely as to give the trees the aspect before alluded to. I can not account for this abnormal increase, as, although the lerp insects are common enough in the forests around Melbourne, never before in over fifty years of occasional bush life have I seen these singular waxy coverings in such great profusion. This season has been a hot one, and the lerp is by no means confined to the one species of Eucalyptus. It will be interesting to note how far the trees will be affected, and I hope to supplement this short note very soon.—CHARLES FRENCH, *Government Entomologist for Victoria, Australia.*

A RED SPIDER ON COTTON.

Under instructions from the Entomologist the writer proceeded, July 9 to 10, 1904, to Batesburg, S. C., in order to ascertain the primary cause of injury to cotton which had been reported in that section, whether red spider or some disease of the plant.

On the plantation of Mr. E. F. Strothers was found a small field of cotton in which a red spider was becoming common. The field was first attacked, according to Mr. Strothers, on the south side, or nearest the road, and was found infested for a distance of some 200 or 300 yards into the field. Some plants were already dead, while others had lost nearly all of their leaves. The leaves at first have the peculiar scarlet appearance due to the attack of this mite. This coloring occurs between the larger ribs, near the base of a leaf, and gradually spreads in all directions. As the injury becomes common over the leaf, the red color dies out, giving place to a dirty yellow, which later fades out, and the leaf shrivels and falls. Larger and older leaves are attacked first and soon commence to curl; younger leaves, when attacked, do not curl until injury has spread quite extensively over the leaf. The mites also attack the squares, flowers, bolls, and stems.

These mites were found on five plantations in and around Batesburg, and in every case north or northeast of water oak or elm trees

that had been injured by red spiders earlier in the year—presumably this species.

On Mr. Cunningham's place violets and roses had been injured by this red spider, these plants being in a northerly direction from seriously affected water oaks. Across the road from this place is a small piece of cotton which was the most seriously affected of any seen. A field adjoining the yard and west of the house showed no injury. Earlier in the year this region was visited by strong southerly winds, and it is quite probable that the species living on the shade trees at that time were carried into the cotton fields.

On Mr. Mitchell's plantation, 2 miles out of town, injury was slight, but the red spiders could be found over a considerable portion of the field. Other cotton fields on this place and between here and Batesburg showed no injury, not a specimen being found. Cotton fields in all directions from Batesburg were visited and general conditions were the same in all cases.

Several insects (such as grasshoppers and smaller Hemiptera) were found on cotton leaves in infested fields with young red spiders attached to them.

From material collected by the writer Mr. Nathan Banks determined the species as *Tetranychus gloveri* Bks.—E. S. G. T.

SOME SUGAR-CANE INSECTS.

Anomala semilivida Lec. and *Myochrous denticollis* Say were found feeding on leaves of sugar cane and corn at Berwick, Morgan City, Broussard, Billeaud, and Olivier in April and May, 1904. At Broussard they occurred in all the fields visited; at other places they were rare. At Berwick small red ants were noticed carrying living adults of *M. denticollis* to their nests.

Larvæ of the bollworm (*Heliothis obsoleta* [*armiger*] Hbn.) were found very rarely, feeding on the upper unfolded cane leaves in early spring, working downward from above.

The sugar-cane borer (*Diatræa saccharalis* Fab.) was quite rare in young stalks in the spring, but in the fall some fields of "Trinidad" cane near Berwick were quite badly infested.—E. S. G. T.

SOME OBSERVATIONS ON KANSAS INSECTS.

We are in receipt of a communication from Mr. F. F. Crevecoeur, Onaga, Kans., in which he reports a few observations made during 1904.

During the fall he observed the twelve-spotted cucumber beetle (*Diabrotica 12-punctata* Ol.) feeding on apples that had been injured by birds or other insects.

The cotton worm (*Alabama argillacea* Hbn.) and a common wasp (*Vespa germanica* Fab.) were also quite abundant, feeding on apples. The wasp especially was observed to eat apples so that nothing was left but the skins.

October 2 a curculio, *Conotrachelus posticatus* Boh., was observed feeding on apple.

May 15 one of the willow weevils, *Dorytomus mucidus* Say, was observed in the pupal stage under stones by the water's edge along a creek. The adult issued two days later.

June 15 he observed a dipteron, *Ecthodopa pubera* Loew., feeding on a wild bee of the genus Halticus.

A moth, *Glaphyria* (*Homophysa*) *sesquistrialis* Hbn., was reared from larval cases in the nests of the ant, *Cremastogaster lineolata* Say.

July 23 a large robber fly of the family Asilidæ, *Promachus vertebratus* Say, was observed attacking a tachinid fly, *Jurinia aterrima* Desv. The Asilid mentioned is often seen attacking *Melanoplus atlanis* Riley and other grasshoppers.

One of the long-horned grasshoppers, a species of Orchelimum, doubtfully referred to *vulgare*, was seen September 19 eating an adult soldier beetle, *Chauliognathus pennsylvanicus* DeG.

SOME LOCAL NAMES FOR COMMON INSECTS.

During August, 1904, we received a number of insects from Hon. J. D. Mitchell for identification and as a donation to the National Museum, with notes on their habits and the local names applied to them. The most interesting species are as follows:

Pyrophorus physoderus Germ., from Jackson County, Tex., known as the "hominy beater," a name which it shares with *Alaus oculatus* Linn. and other "snap bugs" as far north as Washington, D. C. This species is luminous, having luminous spots on the thorax.

Monedula carolina Drury, the "cicada wasp;" digs holes in the sand and has been seen killing cicadas frequently, but no other insects.

Dasymutilla orca Blake, the "cow-killer ant;" a solitary species.

Arachnophroctonus ferrugineus Say, the "red spider hawk;" kills spiders and buries them. An individual was observed dragging along a large gray spider.

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